

Bottomfish and Seamount Groundfish Fisheries of the Western Pacific Region

1995 Annual Report



August 1996

Western Pacific Regional Fishery Management Council
1164 Bishop Street, Suite 1405, Honolulu, Hawaii 96813

Cover photo: Fresh Island Ehu on the Auction Floor.
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1995 Annual Report

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Prepared by the Bottomfish Plan Team and Council Staff
for the

Western Pacific Regional Fishery Management Council
1164 Bishop Street, Suite 1405, Honolulu, Hawaii 96813
Tel: (808) 522-8220, Fax: (808) 522-8226

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quantifiable and measurable, such as to identify signs of stress in the stocks of the fishery. Based on changes over time in indicator levels, the Bottomfish Plan Team (BPT) may identify "yellow light" situations (i.e., when there is less concern) and recommend that either management action or additional study be undertaken.

The annual report is organized as follows: The introduction section defines and briefly explains the objectives and structure. The next section briefly summarizes the work in each year and includes briefly through the current year, and recommends any areas of concern for each island area. Reports from each island area are appended. The introduction describes the history and present characteristics of the fishery. Results of the year's activities and indicators are presented in tables, in addition to any temporal trends. Figures are supported with information on location of the fish, methods of collection, and data interpretation. Table 1 summarizes all descriptive statistics for the region. The appended report from each area includes with a summary, which addresses progress made in the previous year's recommendations, and new recommendations. Finally, additional appendices contain information on NMFS 1995 enforcement and enforcement activities, habitat conditions, protected species occurrence, and 1995 BPT membership.

Table 2 lists scientific names of species targeted for each indigenous culture for harvest and management that occurs in each area (American Samoa, Guam/Northern Mariana, and Hawaii).

1.1. Definition of "fishery"

The fishery objectives are defined as follows:

1.1.1. Landings information

Four series information are aggregated for each island area except recent years in total bottomfish harvest. The American Samoa and Guam subtotals of both the commercial landings and the total landings (commercial and recreational and subsistence) are provided. For Hawaii and the Northern Mariana Islands, subtotals represent only the commercial harvest.

Bottomfish and Seamount Groundfish Fisheries of the Western Pacific

1995 Annual Report

1.0 INTRODUCTION

The 1995 annual report provides a set of descriptors and indicators of the bottomfish fisheries from American Samoa, Guam, Hawaii and the Northern Mariana Islands. The descriptors are designed to document recent trends in landings, effort, participation, revenue and prices. Should management action be recommended, descriptor information will aid in assessing potential impacts of the action on fishery participants. The indicators are quantifiable and measurable tools used to identify signs of stress in the stocks or the fishery. Based on changes over time in indicator levels, the Bottomfish Plan Team (BPT) may identify "yellow light" situations (i.e., where stress is first detected) and recommend that either management action or additional study be undertaken.

The annual report is organized as follows: The introduction section defines and briefly explains the descriptors and indicators. The next section briefly summarizes time trends in descriptor and indicator levels, through the current year, and recommends any areas of concern for each island area. Reports from each island area are appended. The introduction describes the history and present characteristics of the fishery. Results of the year's descriptors and indicators are presented in detail, in relation to past temporal trends. Figures are supported with information on source of the data, methods of calculation, and data interpretation. Table 1 summarizes 1995 bottomfish statistics for the region. The appended report from each area concludes with a summary, which addresses progress made on the previous year's recommendations, and new recommendations. Finally, additional appendices contain information on NMFS 1995 administrative and enforcement activities, habitat conditions, protected species interactions, and 1995 BPT membership.

Table 2 lists scientific, common English and local/indigenous names for bottomfish management unit species for each area (American Samoa, Guam/Northern Marianas, and Hawaii).

1.1 Definition of Descriptors

The fishery descriptors are defined as follows:

1.1.1 Landings information

Time series information on aggregate catch for each island area shows recent trends in total bottomfish harvest. For American Samoa and Guam, estimates of both the commercial landings and the total landings (combined commercial, recreational and subsistence) are available. For Hawaii and the Northern Marianas, landings information represents only the commercial harvest.

Table 1. Regional Summary of 1995 Bottomfish Statistics

	HI						
	AS	GU	MP	All	MHI	Mau	Hoomalu
BMUS Landings (lb)	25,554	29,891	30,522	903,000	440,000	210,000	253,000
Revenue (\$)	56,340	44,024	103,030	2,574,000	1,549,000	*3	*3
No. of Boats	25	422	33		784	10	6
No. of Trips	175	4760	313		7,182	88	31
CPUE	16.5 lb/hr	4.0 lb/hr	98 lb/trip	--	180 lb/trip	2,460 lb/trip	5,543 lb/trip
SPR	0.55	--	--	--	*1	*2	*2

- 1) Species with Spawning Potential Ratio near or below critical level of 0.20 (recruitment overfished): onaga (SPR = 0.06);
 chu (SPR = 0.07); hapuupuu (SPR = 0.20)
- 2) Healthy (SPR > 0.20) for all species
- 3) Revenue for NWHI zones combined was \$1,025,000

Table 2. Bottomfish Management Unit Species (BMUS) Names

(Absence of an indigenous name implies no local name established or area is not within the species' geographic range.)

Scientific	English Common	American Samoa	Guam/CNMI	Hawaii	
Bottomfish:					
<i>Aphareus rutilans</i>	red snapper/silvermouth	palu-gutusiiva		maraap tatoong	lehi
<i>Aprion virescens</i>	gray snapper/jobfish	asoama		tosan	uku
<i>Caranx ignobilis</i>	giant trevally/jack	sapoanae		tarakito	white ulua/pau'u
<i>C. lugubris</i>	black trevally/jack	tafauli		trankiton attilong	black ulua
<i>Epinephelus fasciatus</i>	blacktip grouper	fausi		gadao matai	
<i>E. quernus</i>	sea bass				hapu'upuu
<i>Etelis carbunculus</i>	red snapper	palu-malau		guihan boninas	ehu
<i>E. coruscans</i>	red snapper	palu-loa		onaga	onaga
<i>Lethrinus amboinensis</i>	ambon emperor	filoa-gutumumu		mafuti/lililok	
<i>L. rubrioperculatus</i>	redgill emperor	filoa-pa'o'omumu		mafuti tatdong	
<i>Lutjanus kasmira</i>	blueline snapper	savane		sas/funai	ta'ape
<i>Pristipomoides auricilla</i>	yellowtail snapper	palu-i'usama		guihan boninas	yellowtail kalekale
<i>P. filamentosus</i>	pink snapper	palu-'ena'ena		guihan boninas	opakapaka
<i>P. flavipinnis</i>	yelloweye snapper	palu-sina		guihan boninas	yelloweye opakapaka
<i>P. seiboldi</i>	pink snapper			guihan boninas	kalekale
<i>P. zonatus</i>	snapper	palu-sega		guihan boninas/gindai	gindai
<i>Pseudocaranx dentex</i>	thicklip trevally			terakito	butaguchi/pig ulua
<i>Seriola dumerili</i>	amberjack			guihan tatdong	kahala
<i>Variola louti</i>	lunartail grouper	papa		bueli	
Seamount Groundfish:					
<i>Beryx splendens</i>	alfonsin				kinmedai (Japanese)
<i>Hyperoglyphe japonica</i>	ratfish/butterfish				medai (Jap.)
<i>Pseudopentaceros richardsoni</i>	armorhead				kusakari tsubodai (Jap.)

In Hawaii, changes in species catch composition are provided for the Main Hawaiian Islands (MHI) and the Northwestern Hawaiian Islands (NWHI). Statistical tests for consistency in catch composition over time and between areas are included. Where possible, descriptor information has been presented for each NWHI management zone: Hoomalu and Mau. For 1995, pounds landed by species are presented in tabular form for each area except Hawaii. For Hawaii, NWHI bottomfish management unit species (BMUS) landings by species are provided for 1986 through 1995.

1.1.2 Effort information

Effort is measured in number of trips for Hawaii and the Northern Marianas, and in both hours fished and trips taken for American Samoa and Guam.

1.1.3 Participation information

Estimates of the number of vessels making bottomfish landings are provided for all areas.

1.1.4 Economic information

Time trends in economic performance are characterized by plots of total ex-vessel revenue, aggregate average price levels, and for Hawaii, price trends over time for major species. In time-series of prices and revenues, it is appropriate to adjust value for the rate of inflation so that values throughout the time period are comparable (based on a consistent purchasing power for the dollar). Both the unadjusted and adjusted aggregate average price and aggregate revenues are plotted to clarify the relative change over time.

1.2 Definition of Indicators

Indicators were developed as tools for identifying signs of stress in the stocks or the fishery which deserve further investigation and/or a management response. Analyses consider how the indicators change over time. Indicators from Hawaii include 95% confidence intervals. To the degree possible, similar variance estimates are expected from the other areas in future annual reports. The indicators are defined as follows:

1.2.1 Aggregate Catch-Per-Unit-Effort

If the current year's aggregate catch-per-unit-effort (CPUE) is less than 50% of the average aggregate CPUE for the first three years of available data, there may be cause for concern. CPUE information is available for all areas; research CPUE is available for SE Hancock Seamount for all years since 1985, except 1992, 1994 and 1995.

1.2.2 Mean Fish Size

If there has been a significant reduction in mean fish size for a species over time, the stock may be stressed by the fishery. Mean size information is provided for nine species in Hawaii. No mean size information was available at this time for American Samoa, Guam or the Northern Marianas.

1.2.3 Percent Immature

If over 50% of the catch for a species is below the size of first maturity, the stock may be stressed by the fishery. Information for this indicator is available only from Hawaii.

1.2.4 Spawning Potential Ratio

The spawning potential ratio (SPR) is the ratio of the spawning stock biomass per recruit, at the current level of fishing, to the spawning stock biomass per recruit that would occur in the absence of fishing. According to the overfishing definition contained in the Bottomfish FMP (Amendment 3, 1990), if SPR is less than or equal to 0.20, recruitment overfishing has occurred (i.e., spawners have been reduced to 20%, or less, of their unexploited stock level). Data to calculate SPR were not available from Guam or the Northern Marianas. An estimate of the "worst case" SPR was calculated for American Samoa's bottomfish complex using Dory Project data to estimate the virgin population CPUE and information on percent of immature fish from Hawaii. In Hawaii, SPR was calculated for five major species in the Hoomalu and Mau Zones, of the NWHI, and the MHI; some SPR values changed slightly from previous year's reports due to improvement in the calculations. SPR for armorhead was calculated annually since 1985, except for 1992, 1994 and 1995.

1.2.5 Economic Indicators

Revenue per trip plots are presented for all areas except the MHI. A more valuable indicator for the commercial fisheries, which may be available in the future, would be net revenue (ex-vessel revenue minus costs per trip).

2.0 AREA SUMMARIES

2.1 American Samoa

2.1.1 Descriptors

Bottomfish landings, which declined from 1988 to 1992, rose slightly in 1993 and dramatically in 1994. The decline was attributed to the following: the three hurricanes that struck the territory (in 1987, 1990 and 1991), the departure of several highliners from the

fishery, the shift in importance from bottomfishing to trolling, and the substitution of imported fish from Western Samoa and Tonga. The 1995 total landing decreased 22% from the 1994 landings, but remained higher than years prior to 1994. The significantly greater 1994 total landings, when compared to the previous years, occurred primarily due to improved catch recording, an increase in effort by highline vessels, and a high fish demand for government and cultural events.

Fishing effort, measured by the number of trips, declined 26% in 1995. Rather than indicating a problem with the resource, the decrease in effort was primarily due to highliners redirecting their effort from the bottomfish fishery to more the productive and lucrative longline fishery.

The average price per pound (\$1.88) dropped in 1995 to levels similar to 1983. This decrease is consistent with a general trend since 1991. Inflation-adjusted values have experienced fluctuations no greater than 11% from 1985-1994, with the 1994 average price near the high end of the range. Prices of locally caught fish were kept low due to the large amount of imports.

2.1.2 Indicators

CPUE (pounds per hour), relatively stable (at about 10 lb/hr) in the early 1990's, has increased the last three years (up 21% in 1995) indicating a healthy fishery. The proxy "worst case" SPR was 0.55 in 1995, indicating that recruitment overfishing has not occurred. Size and maturity data were collected from key species, but insufficient sample sizes were available for a more realistic SPR estimation. Bottomfish revenue per trip (as opposed to total revenue) increased 21% in 1995.

2.1.3 Recommendations

1) DMWR redirected its efforts from collecting maturity data from its shallow-water bottomfish complex to dissecting deep-water snappers (mainly *E. coruscans* and *E. Carbunculus*) towards a new Bottomfish Assessment Project. DMWR plans to hire a new biologist who would be responsible for the collection of maturity data, for the PMT-recommended SPR project mentioned in last year's report.

2) DMWR finds that the length and maturity data program should continue and be made a high priority as the information collected is crucial for reliably estimating SPRs.

2.2 Guam

2.2.1 Descriptors

The fairly large fluctuations over time in bottomfish landings in Guam appear to be due more to entry and exit patterns of fishermen, rather than changes in fish stocks. The number of highliners fishing in the area doubled from 1993 to 1994 increasing the total commercial BMUS

harvest and revenue by nearly 300% during that year. In 1995, the total BMUS landings and total commercial harvest declined 39% and 56%, respectively. These reductions are best explained by the absence or reduced effort of about six highlanders who combined, have landed an average of 18% of the total BMUS harvest during the last four years and 68% of the unexpanded total commercial landing for the same period.

Although the total BMUS landings decreased 17% in 1995, and total bottomfish harvest increased 23%, due primarily to a 58% increase in recreational and subsistence-type boats participating in the fishery this year. The 1995 total number of boat hours and trips increased nearly 60% due to the recreational and subsistence-type boats and the calm seas throughout most of 1995 which allowed many of them to participate in bottomfishing more often than usual. The 1995 statistics are, however, representative of a general increasing trend which began in 1986.

The adjusted average price for bottomfish has not shown consistent marketing trends. This is believed to have resulted from the seasonal supply of pelagic fish and difficulties in developing a consistent market for locally caught fish. In addition, imported fish from other islands around the region have contributed to the continued marketing problem for local fishermen.

2.2.2 Indicators

In 1995, the CPUE has fallen to all time low of 3.2 lbs per hour. Based on an aggregate catch-per-unit-effort average of 6.9 lb/hr for the first three years of data collection on Guam, the 1995 figure places the fishery in a "yellow light" situation for the first time. However, it is important to note that CPUE is affected considerably by the predominance of recreational and subsistence-type effort that does not target most of the BMUS species of primary concern.

The adjusted average revenue per trip does not appear to show any long-term trend or cause for concern. The substantial increases in both actual and inflation adjusted revenue per trip occurring in 1994 are best explained by the success of the highliner vessels. The 1995 increase in revenue for all species landed verses the decrease in revenue for bottomfish only, indicated that on average, most commercial fishermen continue to make more money from their trolling efforts than from bottomfishing.

2.2.3 Recommendations

1) Recognizing that the results derived from the spreadsheet format presently being used for Guam's BPT annual reports are not completely representative of the data analysis required by the Council, and that this deficiency continues to jeopardize confidence in the data presented for Guam reports, an effort to rectify this shortcoming should be pursued immediately, specifically:

- a. Contract a private vendor to develop a customized computer program that will update, standardized and reprocess the DAWR creel survey database as well as meet the Plan Team's annual reporting requirements;
- b. consider an additional contract for the immediate implementation, input and processing of the DAWR creel survey database from 1991 to present;

- c. train designated DAWR staff to use the new software and to interface with NMFS software to facilitate additional support in the processing and analysis of fisheries data if necessary.

2) The need to complete a baseline biological survey of the red-gilled emperor (*Lethrinus rubrioperculatus*) remains as the single most important data deficiency for the Marianas shallowwater bottomfish resource. Thus, the previous recommendation, in the 1992 through 1995 Guam annual reports, to establish a joint program with the CNMI, continues to be a priority; especially in light of the fact that the window of opportunity to conduct such a project with the CNMI's virgin stocks is rapidly closing as commercial bottomfishing operations continue to grow in number and increase their fishing effort.

3) With the assistance of the National Marine Fisheries Service, calculate the mean fish size, percent immature and spawning potential ratio (SPR) for Guam's deep *and* shallowwater bottomfish complexes; especially since Guam has gone into a "yellow light" situation based on the aggregate CPUE indicator.

2.3 Hawaii

2.3.1 Descriptors

Main Hawaiian Islands: Only commercial data are available for both the MHI and NWHI fisheries, even though in the MHI recreational/subsistence catch is estimated to be about equal that of commercial landings. In 1988, there was a dramatic increase in MHI bottomfish landings due to a bonanza uku (gray snapper) harvest. Since that time there has been a steady decline in total landings, which stabilized from 1990-1992. Landings in 1994 went up 32% over 1993 (which was the lowest recorded annual value), then dropped slightly in 1995. The slight decrease in MHI landings for 1995 occurred despite a 16% increase in effort.

Total ex-vessel revenue from the MHI has shown a general decline from 1988-1995, mainly due to decreased landings, but inflation-adjusted average price appears to be relatively stable in recent years.

NWHI Mau Zone: Mau Zone 1995 landings have increased 31% over 1994. The total number of boats decreased from 12 to 10, with the number of trips decreasing by 11%. In addition, bottomfish landings per trip decreased by 34%.

NWHI Hoomalu Zone: Hoomalu Zone 1995 landings decreased slightly from 1994. Six total boats fished in the zone (one more than last year), while the number of trips decreased by 24%. In addition, bottomfish landings per trip increased by 20%.

Available revenue data are not separated by zone. Overall NWHI inflation-adjusted revenue has been relatively stable since 1990. Inflation-adjusted average bottomfish price appears to be relatively stable in recent years.

2.3.2 Indicators

MHI: CPUE in 1995 decreased to its lowest level on record. Recent CPUE values are less than a third of early (baseline) values, signifying a yellow-light condition in the MHI. This indicator suggests that ehu is the most stressed species with a recent CPUE of only 11% that of the initial years of the fishery. The increase in the late 1980's MHI CPUE was primarily due to a large increase in uku catches, and may not indicate an increase in abundance in other species. Most of the more commercially important species in the MHI have had relatively stable mean weights since 1984. Hapuupuu's mean weight (which dropped sharply in 1993) rose in 1994 then dropped further in 1995. It is the only species which shows a recent decline in mean weight, however, it should be noted that the sample size was small (only 2.5% of the catch). MHI onaga again had the highest percentage of immature fish, and was the only species where over 50% of the catch was consistently immature, signifying a yellow light condition.

For the third year 95% confidence intervals were constructed based on "best" and "worst" case bounds of SPR components (CPUE and percent immature). For the first time we calculated SPR values using both aggregate CPUE, as in previous years, and targeted CPUE which we feel gives a more accurate picture for individual species. Of the five major species for which the SPR indicator was calculated using aggregate CPUE, onaga, opakapaka and hapuupuu had values below the 0.20 "critical" level, indicative of recruitment overfishing, while uku and ehu showed values approaching this level (SPR = 0.23 and 0.24, respectively). The use of targeted CPUE showed a different picture for the four species where targeted trips are available. Here, onaga and ehu SPR's are much worse than indicated using aggregate CPUE (SPR = 0.06 and 0.07, respectively), whereas SPR values for opakapaka and uku are much higher than previously indicated (SPR = 0.31 and 0.39, respectively). Onaga's SPR has now been below 0.20 for the past seven years and ehu for the last ten years (using targeted CPUE), indicating a red light situation for these species. Hapuupuu dropped to 0.20 for the first year using aggregate CPUE and must also be considered in the red light condition.

NWHI Mau Zone: The NMFS CPUE data are only available for the NWHI fishery as a whole since 1984 and by zone since 1988. The NWHI (combined Mau and Hoomalu Zones) NMFS CPUE steadily decreased from 1987 to 1992, rose in 1993, and then dropped to an all-time low of 472 lb/day in 1994, which is 64% of the average of the first 3 years (739 lb/day, 1984-86). This could be the result a return to normal abundance, rather than a decrease in normal fish abundance; but it could also represent declines in some stocks. The reasons are currently unclear. 1995 CPUE data in lbs/day is not yet available. The Mau Zone NMFS CPUE had been steadily decreasing since 1989, but increased 44% in 1994 to 385 lb/day, for reasons unknown. The Mau Zone HDAR CPUE decreased 34% from 1994, with the 1995 value only 42% of the average of the first three years (5,911 lb/trip, 1948-50), indicating a yellow light condition. Non-parametric 95% confidence intervals were calculated for HDAR CPUEs by the "bootstrapping" method. Mean weights of fish in the Mau Zone continue to exhibit year to year fluctuations, but are generally at much higher values than MHI mean weights. The percent of immature fish in the 1993 Mau Zone catch was still safely under 50% for all species evaluated.

The SPR values in the Mau Zone had been decreasing since 1990 (mirroring the pattern in the HDAR CPUE) but experienced a surprising rise in 1994 and return to lower levels in 1995. All values are presently above 0.42, well above the critical level of 0.20. SPR values are higher in the NWHI than the MHI because most of the catch is mature fish. SPR values in both NWHI zones have never fallen below 0.35.

NWHI Hoomalu Zone: The Hoomalu Zone NMFS CPUE has been on a downward trend since 1988, reaching its lowest point in 1994, 1995 data is not yet available. The Hoomalu Zone HDAR CPUE followed an increasing trend, but dropped sharply in 1994 for unclear reasons and rose by 20% in 1995. The 5,543 lb/trip was 66% of the average of the first three years (8,440 lb/trip, 1948-50). Mean weights of fish in the Hoomalu Zone continued to exhibit year to year fluctuations, but are still at much higher values than MHI mean weights. The percent of immature fish in the 1995 catch was still safely under 50% for all species evaluated.

The SPR values in the Hoomalu Zone increased in 1995, with four of the five measured species showing values of 0.77, while onaga had an SPR value of 0.56.

Seamount Groundfish (Armorhead): No fishing has been allowed on the armorhead stocks of the SE Hancock Seamount since the moratorium began in August, 1986. The 1993 CPUE, calculated from research longline catches, was more than double that of the last assessment (in 1991) and nearly as high as the highest CPUE recorded since surveying began in 1985. No research cruise occurred in 1994 or 1995 and future research assessment cruises are unlikely.

No SPR values were available in 1995 as no research was undertaken. In 1993, SPR within the EEZ (SE Hancock Seamount) was above 0.02, the highest since 1986, but still far below (10% of) the threshold level for recruitment overfishing of 0.20. About 99% of the known armorhead seamount habitat occurs outside the EEZ, an area which had 0.06 SPR in 1993. A Japanese research trawl of the seamounts outside the US EEZ is planned for 1997.

2.3.3 Recommendations

1) The BPT remains concerned about the continuing overfished condition of the MHI onaga and ehu stocks. The BPT supports the ongoing efforts of the DLNR bottomfish task force toward establishing management regulations for the MHI fishery and anticipates a timely solution.

2) Again, the BPT strongly encourages the State to proceed expeditiously with computerization of the fish and seafood dealer reporting system and integrate this with the fishermen's commercial catch reporting system.

3) Again, the BPT strongly encourages NMFS and the State to increase the level of bottomfish catch monitoring of the Honolulu auction (reduced from 6 to 2 days per week) and expand this sampling to major dealers on all other main Hawaiian Islands.

2.4 Northern Mariana Islands

2.4.1 Descriptors

Data are available only on the commercial fishery. The declining trend in landings and revenues, which occurred from 1988-91, has been reversed by a growth trend which began in 1992. Bottomfish landings in 1995 are up 42% over 1994 and 96% over 1993, due primarily to the growth of the local bottomfishing industry, particularly from new ventures operating full time. The number of vessels fishing increased 60% in 1994, to 32 and showed little change in 1995 at 33 vessels. The 1994 increase was in vessels of all sizes, including large (50 ft plus) vessels. The number of trips increased 17%, reaching the highest level since 1985. Increased fishing trips is attributed to more full time operations conducting regularly scheduled long trips to the northern islands, where bottomfish are more abundant.

The average price received for bottomfish increased (18%) to \$3.38. The increase in 1995 occurred as the number of major retailers purchasing fish increased above the level of one (a monopoly). The total 1995 ex-vessel revenue almost doubled to \$103,030. The increase is attributed to expanded bottomfish operations, particularly from one full time-full year fishing venture operation. Inflation adjusted growth rates are similar.

2.4.2 Indicators

The average bottomfish catch per trip increased 24% over 1994. The average catch per trip is subject to significant biases (e.g., changes in trip length and relative amounts of bottomfishing compared to trolling). It may be possible to improve this measure of CPUE by using only those trips which landed bottomfish species exclusively. While such a calculation may be sensitive to other biases due to small sample size, it should be investigated in the future. This indicator does not suggest the need for any management action.

Although bottomfish effort and landings are increasing, revenue obtained from bottomfish sales remain relatively stable. The average revenue per bottomfish trip increased 38% for bottomfish species and slightly for all species. All species inflation adjusted revenue, which had been declining since 1988, appears to have not stabilized at this point. Bottomfish fisherman often troll to and from the bottomfishing site, thus acquiring a mixed catch after spending the day "bottomfishing".

2.4.3 Recommendations

1) Establish an immediate three to five year study program that will specifically monitor, assess and analyze bottomfish being landed, especially from the Northern Islands.

2) Baseline (virgin stock) parameters (CPUE, percent immature) for the Guam/Northern Marianas deepwater bottomfish complex (e.g., survey on red-gilled emperor) need to be established utilizing data collected during Resource Assessment Investigation of the Marianas Archipelago (RAIOMA) cruises (1981-1984), the current fishing in the Northern Islands and sampling aboard DFW research vessel to help calculate SPR, with assistance from NMFS.

3) Establish aseline (virgin stock) parameters (CPUE, percent immature) for the Guam/Northern Mariana shallow-water bottomfish complex (e.g., red-gilled emperor) by sampling program aboard DFW research vessel to help calculate SPR, with assistance from NMFS.

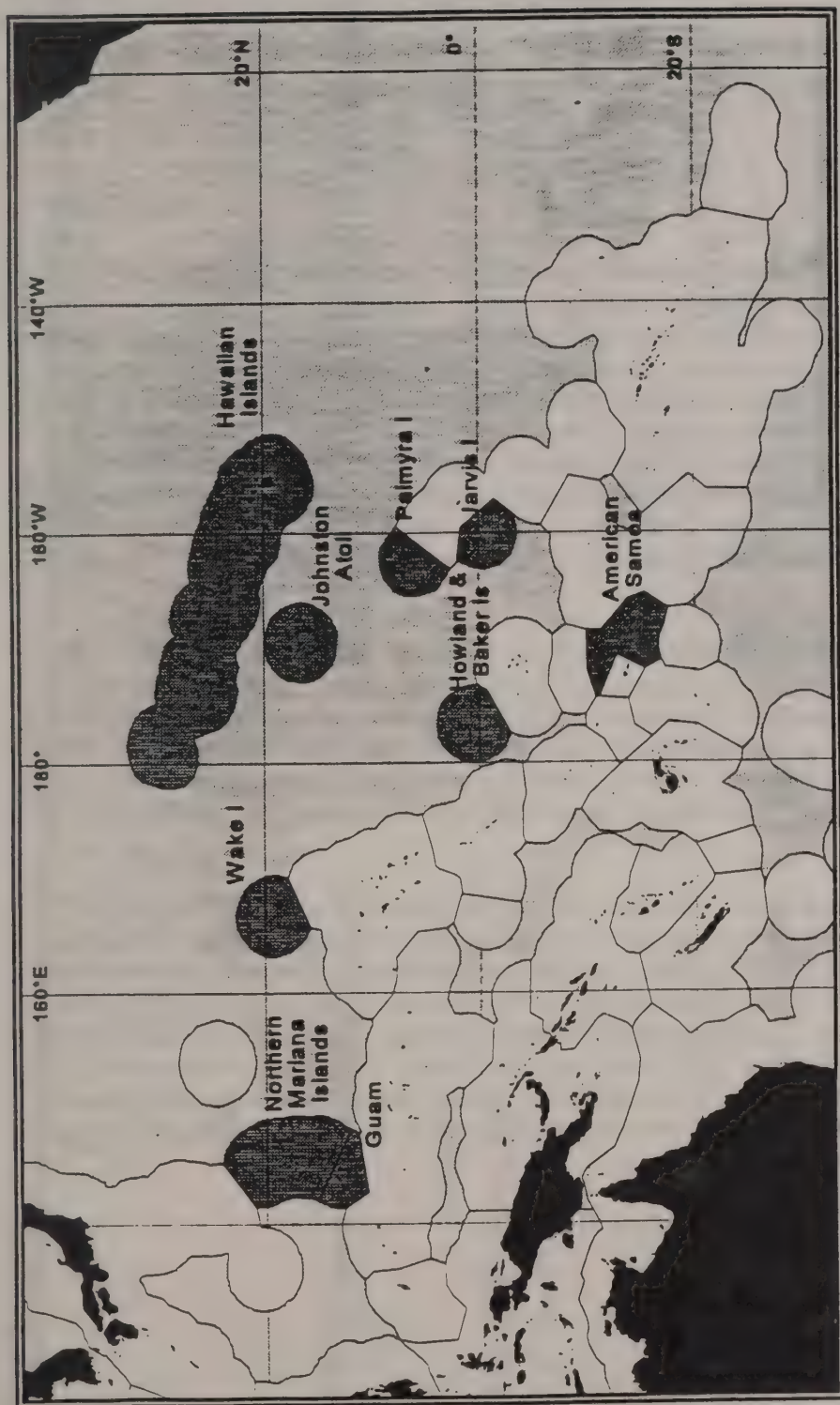
2.5 Region-Wide Recommendations (*as revised at March 96 BPT meeting*)

1) **The BPT concurs with the urgency of the recommendation in the NMI module to establish baseline parameters of the virgin stock for the shallow-water and deep-water bottomfish complexes.** The establishment of the baseline parameters is essential, as now is the only opportunity due to the rapidly expanding northern islands' fishery.

2) The BPT recognizes that the American Samoa, Guam, and the Northern Mariana Islands bottomfish fisheries are comprised of two separate species complexes (the shallow-water emperor based and deep-water eteline/grouper based complexes) that should be analyzed separately. **The Team recommends that the NMFS Honolulu Laboratory staff develop methodology for the collection and analysis of appropriate data (i.e., virgin population catch rates, size at maturity, percent immature, and SPR values) be completed and provided to the respective areas.**

3) The NMFS review of overfishing definitions (by Rosenberg et al., 1994) found the Bottomfish FMP definition of SPR "misleading and ambiguous". **The Team recommends that NMFS evaluate these concerns and respond as soon as possible.**

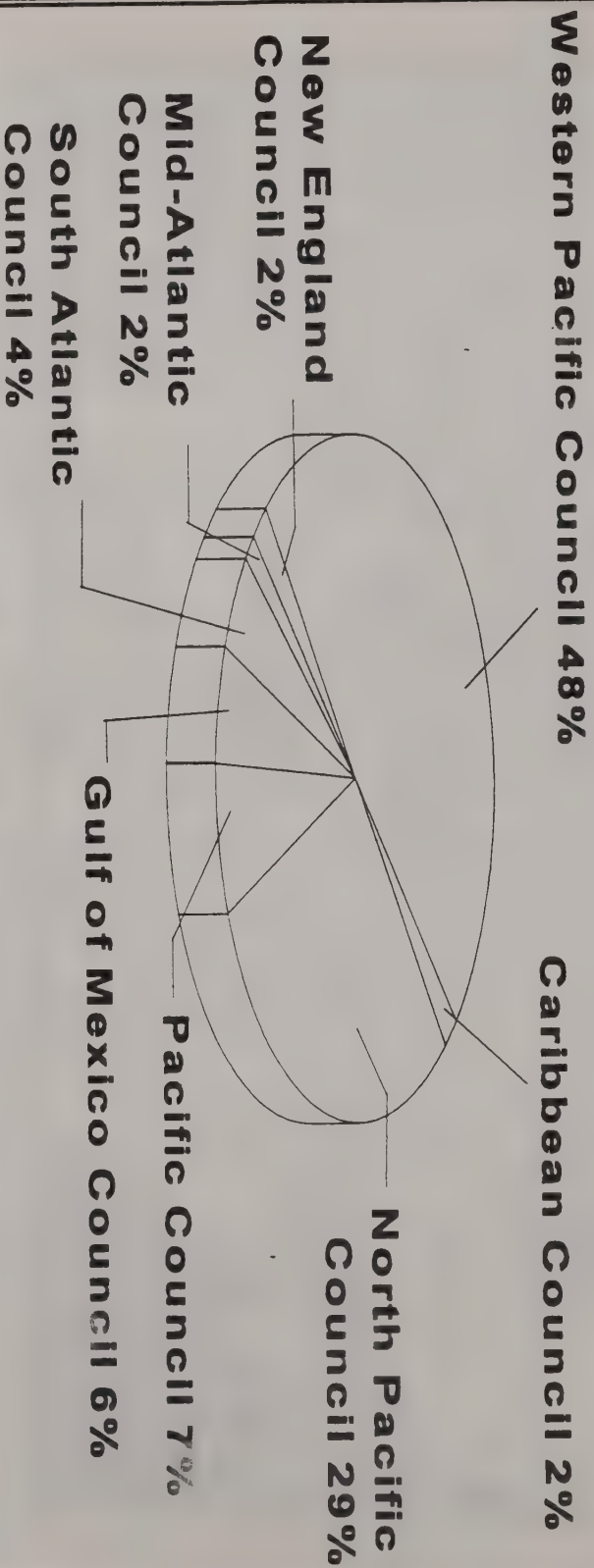
4) The BPT concurs with the area specific recommendations presented in the 1995 annual report modules for American Samoa, Guam, Hawaii, and the Northern Mariana Islands (as detailed below).



Exclusive economic zones (EEZs) of the Pacific Islands. Western Pacific Regional Fishery Management Council's EEZ areas are shown in dark grey

Total Area of U.S. EEZ

3.25 million sq. nautical miles



Appendix 1

American Samoa

Introduction

Bottomfishing from canoes (paopao) by the natives of the American Samoa islands has been a traditional subsistence practice in the distant past. It was not until the early 1970s that the bottomfish fishery developed into a commercial venture utilizing motorized boats. A government subsidized program, called the Dory Project, was initiated in 1972 to develop the offshore fisheries into a commercial venture, and resulted in an abrupt increase in the fishing fleet and total landings. In 1982, a fisheries development project aimed at exporting high-priced deep water snappers to the Hawaii fish auction caused another notable increase in both bottomfish landings and revenue. Between 1982 and 1988, the bottomfish fishery comprised as much as 50% of the total commercial catch. Since 1988, the nature of American Samoa's fisheries has changed dramatically with a shift in importance from bottomfish fishing towards trolling.

During the early 1980s, data were collected for the bottomfish fishery by interviewing only commercial vessels. In the current creel survey that started in October 1985, commercial, subsistence and recreational domestic bottomfish fishermen from five designated areas were interviewed and their catches examined. For two weekdays and one weekend day per week, DMWR data collectors sampled offshore fishermen between 0500 and 2100 hours. Two DMWR samplers based on Tau and Ofu collect fisheries data from the Manu'a Islands fleet.

Boat-based fishing in Tutuila and Manu'a was mostly trolling and bottomfish handlining. This year, a record catch of longline landings by the highliners (Alia commercial fishermen) was recorded. The bottomfish fishery of American Samoa is typically commercial overnight jigging using skipjack as bait, on 28-foot aluminum Alias. Bottomfish imported mainly from the neighboring independent state of Western Samoa has assisted in satisfying the high demand for fresh fish that cannot be supplied by the small local commercial fleet. The adverse effects of three hurricanes that struck American Samoa in 1987, 1990 and 1991 can be seen in some of the trends in the fishery as depicted by the data in this report.

Summary

During 1995, a total of 25 local boats landed an estimated 31,000 pounds of bottomfish in the territory. Revenue for the domestic commercial fishery this year was estimated around \$57,000, with all the catch being sold locally.

The fishery was relatively bigger between 1982 and 1986 than in recent years (Fig. 1). This observation reflects a trend in the loss of skilled and full-time commercial fishermen from the fishery and the shift from bottomfishing to trolling. The December 1991 hurricane contributed to the 1992 decrease in landings (Fig. 1) and the second lowest number of trips ever recorded (Fig. 3). This year's decline in landings, trips, effort and subsequently revenues was mainly due to the highliners' diverting their interest and efforts towards longlining and the continued improvements in sampling.

The CPUE in 1995 (16.5 pounds per hour) was greater than the estimated baseline CPUE, indicating no signs of stress in this fishery. The proxy "estimate of the worst case" SPR (refer to the analysis in Fig. 7) indicated that recruitment overfishing is not occurring in this fishery. Currently available data do not indicate any serious problems with the stocks.

Recommendations

DMWR redirected its efforts from collecting maturity data from its shallow-water bottomfish complex to dissecting deep-water snappers (mainly *E. coruscans* and *E. Carbunculus*) towards a new Bottomfish Assessment Project. DMWR plans to hire a new biologist who would be responsible for the collection of maturity data, for the PMT-recommended SPR project mentioned in last year's report.

DMWR should continue to collect samples for the SPR estimation project as recommended in last year's report.

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Table 1. American Samoa 1995 Estimated Total Bottomfish Landings

Species	Pounds
Redgill Emperor	1032
Ambon Emperor	91
Longnose Emperor	1317
Orangespot Emperor	90
Emperors (misc)	2100
Tomato Grouper	856
Yellowspotted Grouper*	32
Peacock Grouper	467
Lunartail Grouper	2265
Flagtail Grouper	15
Blacktip Grouper	86
Spotted Grouper	93
Giant Grouper	11
Grouper (misc)	585
Pristipomoides/Etelis	144
Bluelined Snapper	3966
Rufous Snapper	5
Stone's Snapper	76
Onespot Snapper	32
Yellowtail Kalekale	81
Yelloweye Opakapaka	685
Gindai	352
Gray Jobfish	2621
Brown Jobfish	217
Onaga	2706
Ehu	3390
Humpback Snapper	1312
Twinspot/red Snapper	158
Hawaiian opakapaka	45
Lehi	681
Oilfish	174
<i>Carangoides</i>	93
<i>caeruleopinnatus</i>	
Bottomfish (assorted)	1741
Amberjack	96
Black Jack	1512
Jacks (misc)	1374
Total Bottomfish	30503
Total BMUS	25554
* Epinephelus sp.	

Calculation: Catches are weighed by species either at landing sites or during the selling of fish to dealers. Analyses of American Samoa's bottomfish data are for the whole complex, not just for BMUS.

Interpretation: The appearance of new species in recent years was due to the improved identification of various species by DMWR samplers. These species were occasionally present in landings from previous years, but were not identified at the species level.

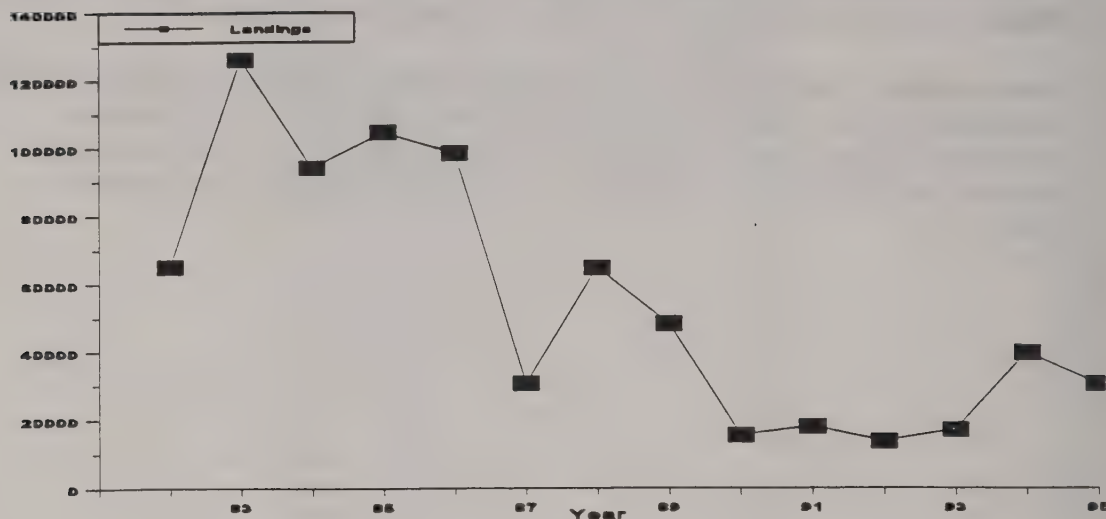
Table 2. American Samoa 1995 Estimated Average Price of Bottomfish Species

Species	Ave. Price (\$/lb)
Redgill Emperor	1.47
Ambon Emperor	1.86
Longnose Emperor	1.72
Orangespot Emperor	1.90
Emperors (misc)	1.75
Tomato Grouper	1.85
Yellowspotted Grouper	1.90
Peacock Grouper	1.75
Lyretail Grouper	1.89
Flagtail Grouper	2.25
Blacktip Grouper	1.78
Spotted Grouper	1.90
Giant Grouper	1.50
Groupers (misc)	1.84
Pristipomoides/Etelis	1.87
Blueline Snapper	1.87
Rufous Snapper	1.54
Stone's Snapper	1.90
Onespot Snapper	1.70
Yellowtail Kalekale	1.87
Opakapaka	1.75
Gindai	1.65
Gray Jobfish	1.93
Brown Jobfish	1.90
Onaga	2.09
Ehu	2.18
Humpback Snapper	1.83
Twinspot/red Snapper	1.85
Hawaiian Opakapaka	1.50
Lehi	1.69
Oilfish	1.80
Trevally	1.81
Bottomfish (assorted)	1.82
Amberjack	1.25
Black Jack	1.76
Jacks (misc)	1.89
Total Bottomfish	1.88
Total BMUS	1.89

Calculation: During creel surveys, the disposition of the catch is recorded, and if sold, the price is obtained whenever possible. The average prices reported in this table are calculated by dividing the total revenue by the weight sold in pounds for each species.

Interpretation: There appears to be no significant changes in the prices of individual species in the past five years. DMWR keeps track of imported bottomfish through a separate Commercial Invoice System. Data from that system reveals that since 1992, the average prices of bottomfish imported from Western Samoa were lower than for locally-caught bottomfish.

Figure 1. American Samoa bottomfish landings



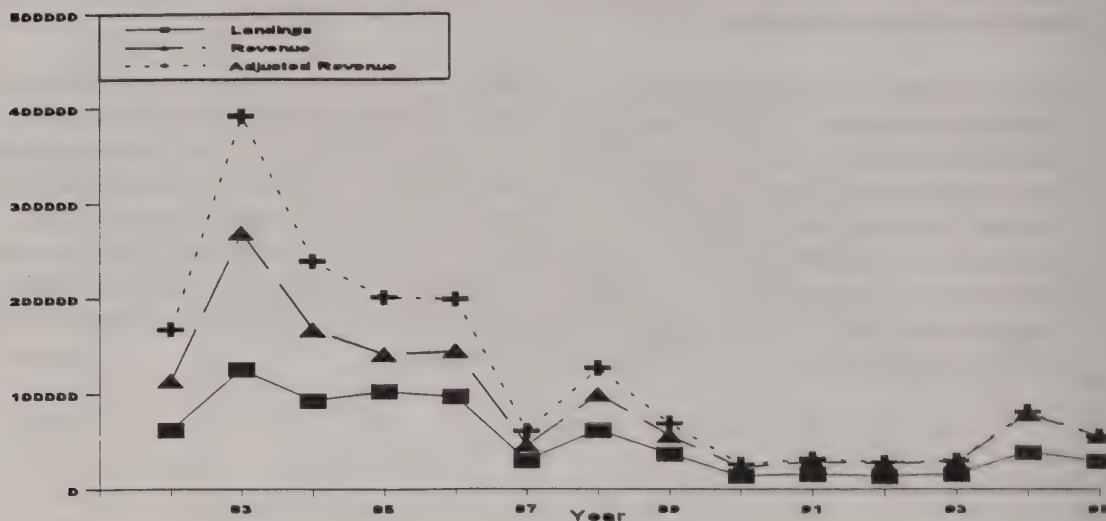
Year	Landings (lb)
1982	64942
1983	126327
1984	94104
1985	104675
1986	98361
1987	30640
1988	64530
1989	48137
1990	15445
1991	17917
1992	13715
1993	17098
1994	39533
1995	30503
Average	54,709
Standard Deviation	37,941

Calculation: Bottomfish landings for 1982-84 are calculated by adjusting the sampled Tutuila data by the calculated annual percent coverage of the fleet, and then adding the similarly adjusted Manu'a landings. The 1986-present landings are from the creel survey expanded species composition files (*.SPC) which contain the annual estimated total landings by species

for Tutuila, and then adding the adjusted Manu'a landings. Calculating statistics for 1985 is more complicated because the sampling program changed from commercial fleet sampling only to creel sampling on October 1, 1985.

Interpretation: The substantial declines in landings in 1987 and 1990 were partially due to vessel losses caused by two hurricanes. Boat repairs were delayed as fishermen repaired or rebuilt their houses. In terms of total landings, the bottomfish fishery is much smaller in recent years than it was any time between 1982 and 1986, a period when there was a relatively large fleet and fishermen were attracted to the then profitable bottomfish export program. The significant increase last year was due primarily to improved sampling on Tutuila and increased efforts by the Tutuila highliners. Furthermore, the Manua landings more than tripled due to social/cultural events. The decrease this year can be attributed to the highliners diverting their efforts to longlining and the continued improved sampling.

Figure 2. American Samoa annual estimated commercial bottomfish landings.



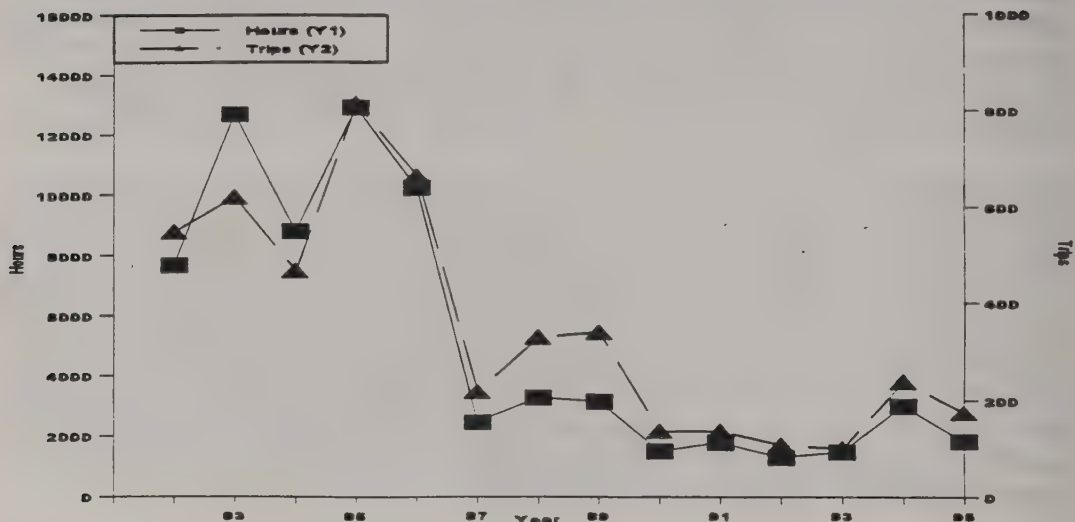
Year	Commercial Landings	Revenues	Inflation-Adjusted Revenues
1982	62,016	113,678	167,107
1983	125,167	269,083	392,323
1984	92,841	166,917	238,858
1985	102,670	141,495	200,639
1986	97,540	144,742	198,730
1987	30,236	46,537	61,196
1988	61,897	99,482	126,840
1989	37,438	56,433	68,961
1990	13,992	23,161	26,265
1991	16,296	29,439	31,971
1992	13,663	27,450	28,630
1993	16,146	29,160	30,384
1994	39,126	79,536	81,286
1995	30,010	56,340	56,340
Average	52,788	91,675	122,109
Standard Deviation	37,888	70,304	106,598

Calculation: A relatively complex set of algorithms are used to estimate the commercial landings from estimates of total landings created by the creel survey data expansion system. In short, the percent sold by fishing method is calculated monthly and multiplied by the percent

species composition by month, then multiplied by the estimated total landings for that method and month. For 1982-85 sampling was conducted on the commercial fleet only (which included nearly all the fishing boats), whereas since 1985 creel sampling has covered all boats (commercial and recreational). Analysis of creel data for 1986-87 indicates that over 98% of the landed bottomfish were being sold. Therefore, it is believed to be valid to compare commercial data for years prior to 1986 to creel survey totals for years since 1986.

Interpretation: Commercial landings mirror the total fishery's declining catches in recent years. Relative to total landings, commercial landings decreased even more substantially in 1989, because the percent of the catch sold by bottomfish fishermen dropped from an average of about 97% in 1982-88 to 78% in 1989. The peak in 1983 portrays the high prices of deep water snappers exported to Hawaii, while the trough in 1987 can be attributed to effects of the 1987 hurricane. The December 1991 hurricane contributed largely to the decreased landings and subsequently a decrease in revenues in 1992. Unfavorable weather continued through May 1992 hindering commercial bottomfish trips. Increased efforts last year produced a notable increase in revenues. This year's decline in total landings (Fig. 1) is mirrored in this year's decrease in commercial catches and revenues.

Figure 3. American Samoa annual estimated bottomfish hours and trips



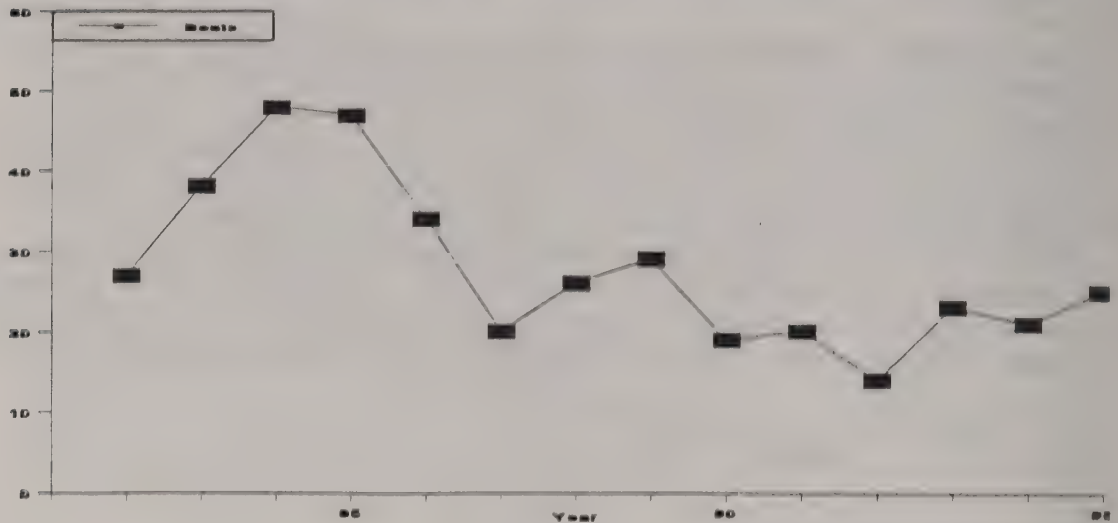
Year	Hours	Trips
1982	7,671	548
1983	12,695	621
1984	8,796	468
1985	12,933	816
1986	10,255	666
1987	2,458	217
1988	3,281	330
1989	3,141	340
1990	1,514	136
1991	1,797	136
1992	1,312	107
1993	1,494	100
1994	3,017	238
1995	1,848	175
Average	5,158	350
Standard Deviation	4,350	235

Calculation: The annual estimated effort (hours) spent bottomfish fishing is calculated by dividing the annual estimated total bottomfish catch by the average CPUE (pounds per hour) from trips doing only bottomfish fishing. The annual estimated number of trips is calculated by dividing the estimated annual hours by the average length of a bottomfish fishing trip. The average length of a bottomfish fishing trip (not shown) is calculated by using only trips which

exclusively bottomfished and for which the trip length was recorded. The total hours fished from those trips is then divided by the number of trips. Recorded hours are trip hours.

Interpretation: The sharp decline in the bottomfish landings since 1986, noted in Fig. 1 is mirrored in this figure by a sharp decline in the level of effort expended in that fishery. Rather than indicating a problem with the resource, this decline depicts an actual trend of commercial boat owners and fishermen seeking other more lucrative and stable lines of work. The noticeable increase in effort last year is primarily due to improved sampling, increased effort by the Tutuila highliners and the significant (about tripled) increase in effort by the Manua fleet. The bottomfish highliners increased their longlining efforts this year and contributed to the decrease in bottomfish trips and effort. The 1994 and this year's figures were greater than the 1990-93 period due to the highliners increased efforts, with some boat owners employing teams (usually 2-3 fishermen) in continuous shifts during good weather.

Figure 4. American Samoa annual estimated number of boats landing bottomfish



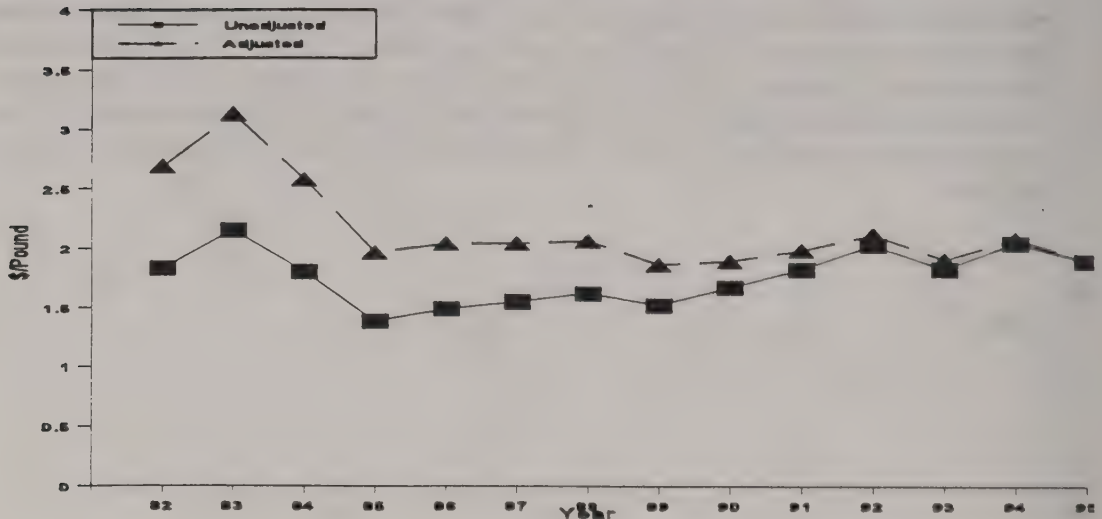
Year	Boats
1982	27
1983	38
1984	48
1985	47
1986	34
1987	20
1988	26
1989	29
1990	19
1991	20
1992	14
1993	23
1994	21
1995	25
Average	28
Standard Deviation	10

Calculation: The annual estimate of the number of boats in the bottomfish fishery is obtained from the data base by counting the unique boats sampled during the year which landed any bottomfish species.

Interpretation: Again, the decline in the fishery since 1985-86 is noted by a decline in the number of boats participating in it. The 1987 hurricane caused the loss of the whole Manu'a

fleet, plus some of the Tutuila fleet. Several boats which contributed to the 1989 bottomfish annual landings did not land any bottomfish in 1990, due to much needed repairs and their participation in non-bottomfish chartered trips. About 90% of the domestic fishing fleet was affected by the December 1991 hurricane, hence the decline in 1992. The increase in 1993 is due mainly to the re-entry to the fishery of a few vessels after repairs, trips by two 14-foot vessels that did not bottomfish in 1992, and the entry of one new alia into the sampling area. A new Alia was bought from Western Samoa and started fishing in the sampling area during this year.

Figure 5. American Samoa average price of bottomfish



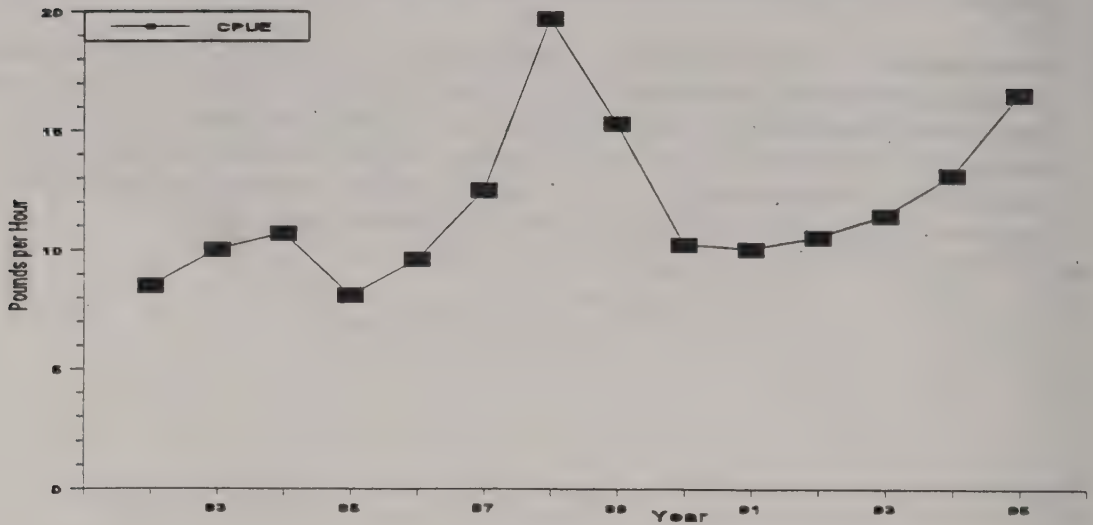
Year	\$/lb	Inflation-Adjusted \$/lb
1982	1.83	2.69
1983	2.15	3.13
1984	1.80	2.58
1985	1.38	1.96
1986	1.48	2.03
1987	1.54	2.03
1988	1.61	2.05
1989	1.51	1.85
1990	1.66	1.88
1991	1.81	1.97
1992	2.01	2.10
1993	1.81	1.89
1994	2.03	2.07
1995	1.88	1.88
Average	1.75	2.15
Standard Deviation	0.23	0.38

Calculation: The average price of all bottomfish species combined is calculated by dividing total bottomfish revenue by total sold weight. The inflation adjusted price is calculated by

multiplying the unadjusted annual average price by the annually calculated consumer price index (CPI) for American Samoa using the current year as the base. The 1995 CPI was 147.

Interpretation: Prices were generally higher between 1982 and 1984 during the exportation of high-priced deepwater snappers to Hawaii. After this period, inflation-adjusted local prices have generally been stable. Prices of locally-caught bottomfish are generally higher than imported fish, and could have been even higher had the local markets not been flooded by imported fish, which are generally of lower quality. The only imported bottomfish this year were from Western Samoa and these were sold at an average price of \$1.67/lb.

Figure 6. American Samoa annual bottomfish CPUE

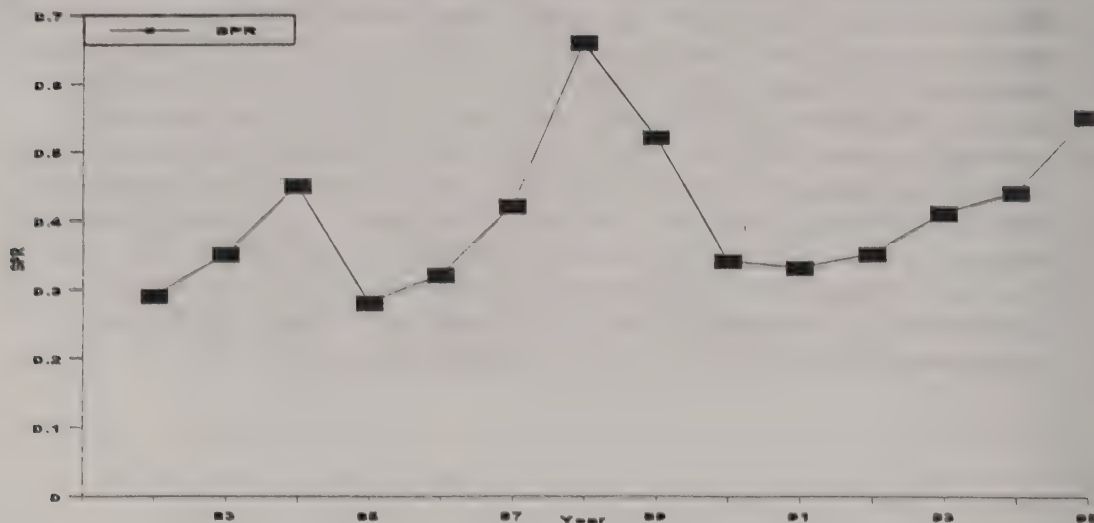


Year	CPUE
1982	8.5
1983	10.0
1984	10.7
1985	8.1
1986	9.6
1987	12.5
1988	19.7
1989	15.3
1990	10.2
1991	10.0
1992	10.5
1993	11.4
1994	13.1
1995	16.5
Average	12.2
Standard Deviation	3.5

Calculation: CPUE (pounds per trip.hours) is calculated using only trips in which only bottomfish method was used and trip hours was recorded. The average is calculated by using each CPUE from each trip as an observation and dividing by the number of trips.

Interpretation: The initial high CPUE in 1983 and 1984 occurred during the intense fishing of some new fishing grounds for deepwater snappers exported to the more lucrative Hawaii auction. A relatively high number of boats and local commercial fishermen participated in the fishery during this period. The drop in 1985 and 1986 might be expected following the ardent harvesting of the limited fishing grounds. Reasons for the CPUE peak in 1988-89 are unknown. The decline in CPUE from 1989 to 1991 can be partially attributed to a combination of new, inexperienced fishermen entering the fishery and the exit of experienced and full-time commercial fishermen. CPUE has essentially remained stable during 1990 to 1992, and has increased since then. Bottomfishing techniques and gear have generally remained the same in the past years with the Alias being the highliners since the early '70s. This year's increase in CPUE (and most probably the 1988-89 CPUE increase) can be attributed mainly to improved sampling and not related to the status of the stocks. Furthermore, this year's CPUE exceeds the estimated virgin stock CPUE.

Figure 7. American Samoa annual estimated spawning potential ratio for bottomfish complex



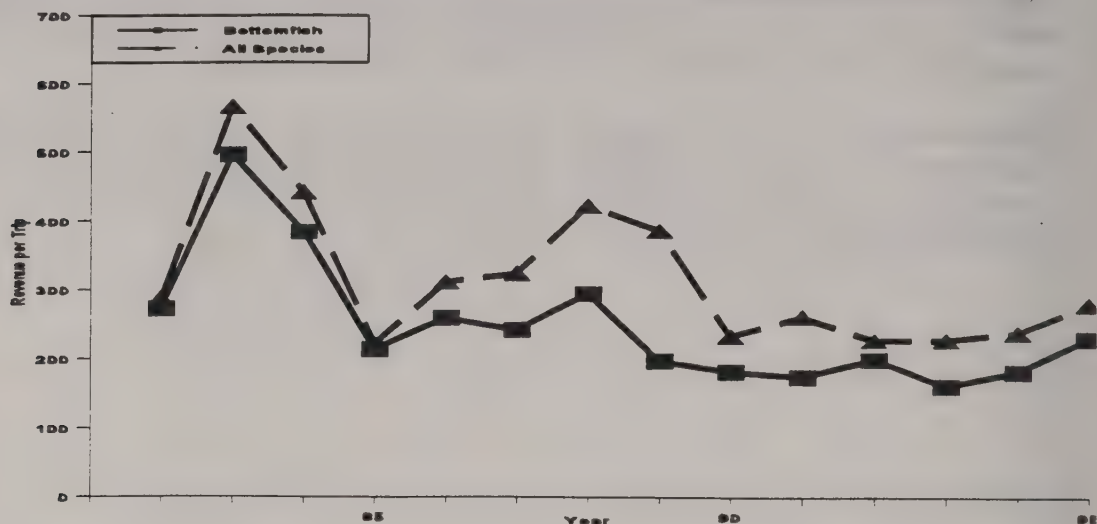
Year	SPR
1982	0.29
1983	0.35
1984	0.45
1985	0.28
1986	0.32
1987	0.42
1988	0.66
1989	0.52
1990	0.34
1991	0.33
1992	0.35
1993	0.41
1994	0.44
1995	0.55
Average	0.41
Standard Deviation	0.11

Calculation: The spawning potential ratio is calculated by dividing the current year's CPUE by the virgin population CPUE, and then multiplying by the ratio of the current percent mature to the virgin population percent mature fish in the catch. To estimate SPR for American Samoa, the "Dory" project mean CPUE (refer to 1990 annual report page 20, Table 3) was used to estimate virgin population CPUE (14.8 lb/hr). Since size and maturity data available

for bottomfish in American Samoa are insufficient, the ratio of percent mature in the catch estimated by substituting the average of the 5 species which have the lowest SPR in Hawaii (in 1991). In this manner a "worst case" SPR was calculated to provide what should be a very conservative estimate of SPR for the American Samoa bottomfish complex.

Interpretation: The proxy "worst case" SPR for 1995 was 0.55, substantially above the 0.20 critical level. According to this indicator, the bottomfish complex of American Samoa is not considered to be recruitment overfished. This year's SPR estimate [refer to above Calculations] increased with this year's increase in CPUE.

Figure 8. American Samoa average inflation-adjusted revenue per trip landing bottomfish



Year	Bottomfish \$/Trip		All Species \$/Trip	
	Unadjusted	Adjusted	Unadjusted	Adjusted
1982	185	272	196	287
1983	341	497	388	566
1984	269	384	309	442
1985	151	214	157	222
1986	189	259	226	311
1987	184	242	246	323
1988	231	294	331	421
1989	162	198	315	385
1990	161	182	205	233
1991	161	175	240	261
1992	192	200	217	227
1993	155	162	218	227
1994	178	182	233	238
1995	230	230	279	279
Average	199	249	254	316
Standard Deviation	53	92	62	103

Calculation: The average revenue per trip for all species is calculated by summing the revenue of all sales for any trip which landed any bottomfish species, and dividing by the number of trips. The average bottomfish revenue per trip is calculated from those same trips

by summing the sales of only bottomfish species and dividing by the number of trips. Figure 8 plots the inflation adjusted bottomfish and all species revenues per trip for the period 1982-94.

Interpretation: The distance between these two lines reflects the relative importance of bottomfish species in the total catch whenever any bottomfish are landed. The prominent importance of bottomfish between 1982 and 1985 occurred during the targeting of deepwater snappers for export. Bottomfish fishing was also the more profitable method of fishing during that period. The relative importance of bottomfish has generally been declining since 1985 as most of the full-time commercial fishermen quit the fisheries. The supply of locally caught bottomfish has been supplemented by bottomfish imported from Western Samoa. Revenues, however, have increased steadily in the past two years.

Appendix 2

Guam

Introduction

Guam has two distinct bottomfish fisheries which can be separated by depth and species. The shallowwater complex (100-500 feet) makes up a larger portion of the total bottomfish harvest and is comprised of an assemblage of reef-dwelling snappers, groupers and jacks of the genera *Lutjanus*, *Lethrinus*, *Aprion*, *Epinephelus*, *Variola*, *Cephalopholis* and *Caranx*. The deepwater complex (500-700 feet) consists primarily of snappers and groupers of the genera *Pristipomoides*, *Etelis*, *Aphareus*, *Epinephelus*, and *Cephalopholis*.

Bottomfishing on Guam is a highly seasonal combination small-scale commercial and subsistence fishery. The majority of the participants are part-time recreational and subsistence fishermen who operate vessels less than 25 feet in length, primarily target the shallowwater bottomfish complex, combine some trolling effort to supplement bottomfishing effort, and seldom sell their catch commercially. Historically, notable increases and declines in Guam's total annual bottomfish harvests have been caused by the respective entry and exit of highliner vessels. These highliner vessels tend to be greater than 25 feet in length and their effort is usually concentrated on the deepwater bottomfish complex. Bottomfishing effort for both recreational fisherman and highliner is highest during the summer months when sea conditions are generally much calmer.

As Guam's tourism industry continues to grow, so too has its charter fishing industry which now includes several bottomfishing boats making multiple two- to four-hour trips daily. Thusfar, two types of charter bottomfishing trips have been identified and surveyed: those from the more typical charter boats involving 3-6 patrons, and those from larger "party-boat" vessels carrying up to as many as 30 patrons on a single trip. Most of these bottomfish charters operate out of the Agat Marina and primarily target the shallowwater complex of bottomfish.

Centrally located on the western leeward coast, the Agana Boat Basin serves as the Island's primary small-boat launch site to fishing areas off the central and northern leeward coast as well as the northern banks. Situated to the south, the Merizo Pier, Umatac Boat Ramp and Agat Marina serve as access points to the southern shores and banks. The Agat Marina in particular, located between the Agana Boat Basin and the Merizo Pier, provides boats trailered from the northern and central portions of the island a closer and more convenient launch site to the southern fishing grounds. Plans to construct three additional boat ramps at presently undeveloped eastern windward launch sites are currently being considered. Once completed, the new boat launches are expected to lead to a significant increase in bottomfishing effort on the eastern side of the island.

The demand for both deep and shallowwater bottomfish continues to exceed the locally-caught supply. Guam's deepwater bottomfish fishery, especially during the absence of highliner vessels, has limited economic importance. The cultural value of its shallowwater complex however, remains high due to the local popularity of this assemblage of fish as food items. Some of the demand for both complexes of bottomfish is offset with imports from other islands throughout Micronesia. The quality, competitive pricing and consistent availability of imported fish has had the effect of discouraging local attempts to supplant foreign catches with Guam-caught fish.

The Bottomfish Management Unit Species (BMUS) are: *Aphareus rutilans*, *Aprion virescens*, *Caranx ignobilis*, *Caranx lugubris*, *Cephalopholis urodeta*, *Epinephelus fasciatus*, *Etelis carbunculus*, *Etelis coruscans*, *Lethrinus amboinensis*, *Lethrinus rubrioperculatus*, *Lutjanus kasmira*, *Pristipomoides auricilla*, *Pristipomoides filamentosus*, *Pristipomoides flavipinnis*, *Pristipomoides seiboldi*, *Pristipomoides zonatus*, *Seriola dumerili* and *Variola louti*. For Table 1, *Cephalopholis urodeta*, *Epinephelus fasciatus* and *Variola louti* comprise the grouper category; *Caranx ignobilis* and *Caranx lugubris* comprise the jack category; and *Lethrinus amboinensis* and *Lethrinus rubrioperculatus* comprise the emperor category.

Summary

Guam's offshore survey data continues to be expanded utilizing a spreadsheet format that does not include complemental statistics of confidence or biological data such as mean species lengths. The establishment of an offshore creel survey at the Merizo Pier in 1991 and the Agat Marina in 1994, as well as the revision of expansion algorithms to expand the offshore survey data in 1995, has increased the confidence in the expansion results using this spreadsheet format. However, species composition is still limited to BMUS and a few other species of major importance. To rectify these data expansion deficiencies, DAWR is currently seeking to contract a private vendor to develop a state-of-the-art database computer program that will provide DAWR with the capability of integrating the offshore survey expansion data with the inshore survey expansion data, and additionally produce statistics of confidence, a compilation of biological data, and a complete species composition analysis. DAWR further intends to purchase additional computer hardware that will facilitate production of annual reports utilizing standardized wordprocessing, spreadsheet and graphics software (i.e., WordPerfect 6.1 for Windows).

Analysis of the Guam bottomfish fishery indicates that the current year's catch-per-unit-effort (CPUE) of 3.2 pounds per hour has for the first time fallen below 50% of the average aggregate CPUE for the first three years of available data (6.9 pounds per /hour). Based on this indicator of fishery stress, a "yellow light" situation has been identified. However, immediate management action is not recommended at this time because supporting evidence that could be provided by other indicators such as mean fish size, percent immature and SPR are not presently available.

Recommendations

1) Recognizing that results derived from the spreadsheet format presently being used for Guam's BPT annual reports are not completely representative of the data analysis required by the Council, and that this deficiency continues to jeopardize confidence in the data presented in the Guam reports, an effort to rectify this matter should be pursued immediately; specifically to:

- a. Contract a private vendor to develop a customized computer program that will update, standardize and reprocess the DAWR creel survey database as well as meet the Plan Team's annual reporting requirements.
- b. consider an additional contract for the immediate implementation, input and processing of the DAWR creel survey database from 1991 to present.
- c. train designated DAWR staff to use the new software and to interface with NMFS software to facilitate additional support in the processing and analysis of fisheries data if necessary.

2) The need to complete a baseline biological survey of the red-gilled emperor (*Lethrinus rubrioperculatus*) continues to be an important data deficiency for the Marianas shallowwater bottomfish resource. Thus, the previous recommendations in the '92 through '95 Guam annual reports to establish a joint program with the CNMI continues to be a priority; especially in light of the fact that the window of opportunity to conduct such a project with the CNMI's virgin stocks is rapidly closing as commercial bottomfishing operations continue to grow in number and increase their fishing effort.

3) With the assistance of the National Marine Fisheries Service, calculate the mean fish size, percent immature and spawning potential ratio (SPR) indicators for Guam's deep *and* shallowwater bottomfish complexes; especially since Guam has gone into a "yellow light" situation based on the aggregate CPUE indicator.

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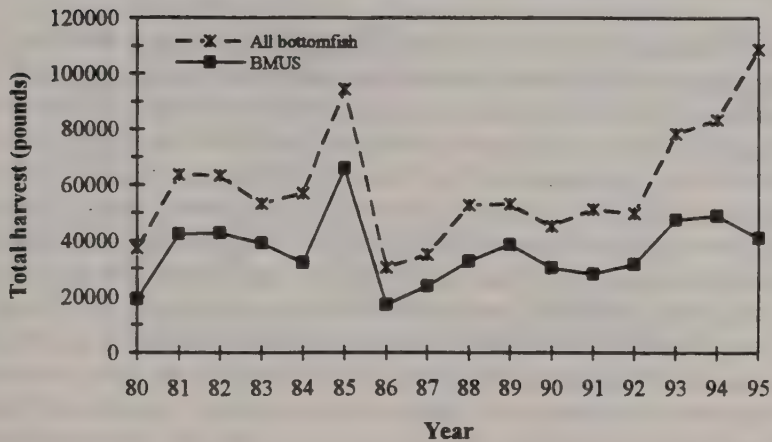
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Table 1. Guam 1995 expanded creel survey composition
of bottomfish management unit species (BMUS)

Species	Bottomfishing method only (lbs)
Lehi (<i>A. rutilans</i>)	1,641
Uku (<i>A. virescens</i>)	2,946
Jacks (<i>C. ignobilis</i> , <i>C. lugubris</i>)	657
Groupers (<i>C. urodeta</i> , <i>E. fasciatus</i> , <i>V. louti</i>)	6,097
Ehu (<i>E. carbunculus</i>)	1,944
Onaga (<i>E. coruscans</i>)	1,576
Emperors (<i>L. amboinensis</i> , <i>L. rubrioperculatus</i>)	12,661
Taape (<i>L. kasmira</i>)	1,397
Kalekale (<i>P. seiboldi</i>)	165
Yellowtail Kalekale (<i>P. auricilla</i>)	5,239
Pink Opakapaka (<i>P. filamentosus</i>)-	1,003
Yelloweye Opakapaka (<i>P. flavipinnis</i>)	1,373
Gindai (<i>P. zonatus</i> , <i>P. argyrogrammicus</i> *)	3,315
Amberjack (<i>S. dumerilii</i>)	912
Total	40,926

*non-BMUS species

Figure 1. Guam Harvest of BMUS and all bottomfish
(bottomfishing method only)



Year	Total bottomfish harvest (lbs)	Total BMUS harvest (lbs)
1980	37,399	19,253
1981	63,654	42,517
1982	63,442	43,428
1983	53,404	39,193
1984	56,998	32,232
1985	94,318	68,141
1986	30,368	17,969
1987	35,033	24,288
1988	52,791	33,724
1989	53,272	39,814
1990	45,374	31,295
1991	51,329	29,962
1992	50,099	34,057
1993	78,355	48,494
1994	83,367	49,169
1995	108,741	40,926
Average	59,872	36,374
Standard deviation	21,618	12,253

Source: The DAWR offshore creel survey data as expanded by computer-based algorithms by method of fishing. All unidentified catch was allocated to species categories based on the species percentage of the total catch.

Calculations: The estimated total landings of the bottomfish species are selected from the expanded creel survey species composition files. However, the expanded estimates of catch by

species must include at least a portion of the catch identified only by generic species codes categories. These generic categories (e.g., "mixed shallow bottomfish") also include some non-bottomfish species according to the FMP definition (e.g., squinelfish).

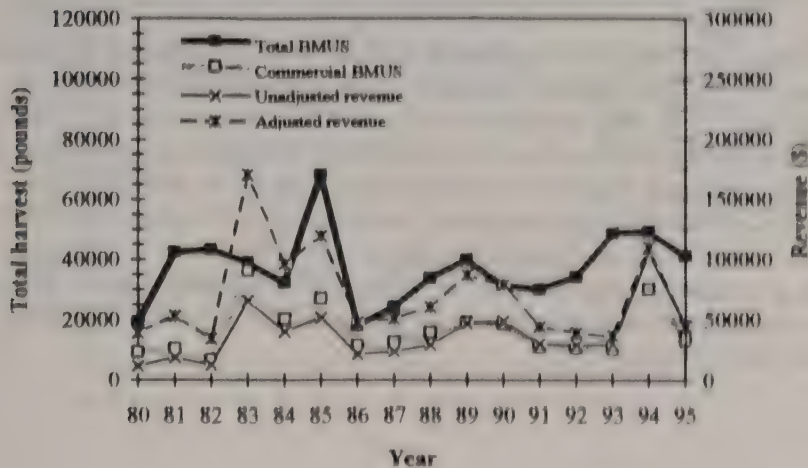
Interpretations: Annual fluctuations in bottomfish landings on Guam are usually due to the number of boats, particularly highliners, entering or leaving the fishery during a given year. The 1985 peak, and apparent crash in 1986, of total bottomfish and BMUS harvests were largely the result of a few highliner fishermen who fished in 1985 and then left the fishery in 1986. Likewise, the 64% average increase in '93-'94 over the preceding years in '91-'92 is mirrored by a similar 64% average increase in the number of boats (see Figure 4) participating in bottomfishing in '93-'94, which also included the reentry of several highliner fishermen. The 23% increase in total bottomfish harvest for 1995 is best explained by the 58% increase in the number of recreational- and subsistence-type boats participating in the fishery this year. Conversely, the 17% reduction in BMUS landings in 1995 are attributed to the absence or reduced effort of several highliners in the fishery. To be sure, an analysis was conducted of the total annual commercial landings of six highliners who combined, have landed an average of 18% of the total BMUS harvest for the last four years and 68% of the unexpanded total commercial landings for the same period. The results indicated a 45% reduction in their total bottomfish harvest this past year dropping from 13,349 pounds in 1994, down to 6,023 pounds in 1995. The 45% drop in highliner landings accounts for about a half of the 1995 decline in total BMUS landings.

Table 2. Guam 1995 commercial bottomfish average price

<u>Species</u>	<u>Average \$/lb</u>
Bottomfish	3.42
Grouper	2.14
Jacks	1.99
Lehi	4.15
Uku	1.97
Ehu	3.97
Onaga	4.95
Opakapaka	4.00
Kalekale	3.34
Gindai	3.90
Emperor	2.84
Amberjack	2.34
All Bottomfish Species	3.29

Note: The source of this information (WPACFIN-originated commercial landings system) is different than the values presented for harvest (DAWR creel survey system) and therefore the species covered may vary slightly between data bases.

Figure 2. Total and commercial BMUS harvest, and revenue



Year	Total BMUS harvest (lbs)	Commercial BMUS harvest (lbs)	Unadjusted revenue	Inflation-adjusted revenue (\$)
1980	19,253	9,381	11,458	39,268
1981	42,517	10,459	18,590	52,888
1982	43,428	6,617	12,753	34,510
1983	39,193	36,281	65,543	171,394
1984	32,232	20,115	40,176	96,624
1985	68,141	27,064	51,777	119,914
1986	17,969	11,482	21,289	47,984
1987	24,288	12,639	23,551	50,847
1988	33,724	15,792	29,568	60,674
1989	39,814	19,442	47,029	87,003
1990	31,295	18,390	48,983	79,353
1991	29,962	10,773	30,234	44,413
1992	34,057	10,334	29,410	39,233
1993	48,494	10,125	29,348	36,128
1994	49,169	30,237	104,827	110,383
1995	40,926	13,381	44,024	44,024
Average	37,154	16,408	38,035	69,665
Standard deviation	12,416	8,419	23,301	38,596

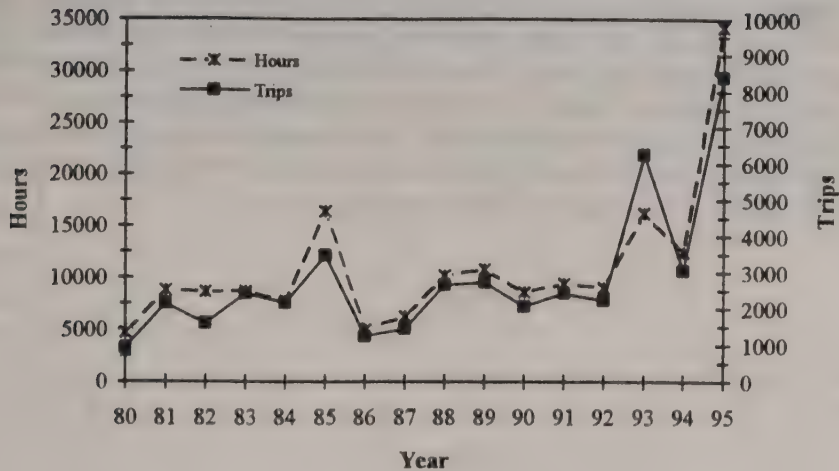
Source: The estimated total landings are from the DAWR creel survey system, and the commercial data are from the WPACFIN-originated commercial landings system

Calculations: The total commercial bottomfish landings and revenue for each year were calculated by summing the weight and value fields in the commercial landings data base and then multiplying by an estimated percent coverage expansion factor. This annual expansion factor was subjectively created and includes an analysis of the "disposition of catch" data available from the DAWR offshore creel survey, an evaluation of the fishermen in the fishery and their entry/exit patterns, general "dock-side" knowledge of the fishery, status of marketing

conditions and its structure, overall number of records in the data base, and a measure of the best-educated guess.

Interpretations: The nearly 300% increase in 1994 of the total commercial BMUS harvest and revenue was the result of additional highliner vessels entering (or reentering) into the fishery during that year. The 39% reduction in total BMUS landings and 56% decline in total commercial harvest for 1995 are best explained by the absence or reduced effort of about six highliners who combined, have landed an average of 18% of the total BMUS harvest for the last four years and 68% of the unexpanded total commercial landings for the same period. Harvest records for these six highliners indicate a 45% reduction in their total bottomfish harvest this past year dropping from 13,349 pounds in 1994, down to 6,023 pounds in 1995. This decline in highliner landings accounts for about two-thirds of the 1995 reduction in total commercial BMUS harvest.

Figure 3. Estimated boat hours and trips



Year	Total hours	Total trips
1980	4,752	929
1981	8,804	2,150
1982	8,621	1,606
1983	8,699	2,401
1984	7,730	2,160
1985	16,477	3,471
1986	5,018	1,246
1987	6,264	1,447
1988	10,208	2,653
1989	10,818	2,732
1990	8,628	2,060
1991	9,440	2,444
1992	9,072	2,234
1993	16,238	6,265
1994	12,512	3,056
1995	17,457	4,763
Average	10,046	2,601
Standard deviation	3,856	1,340

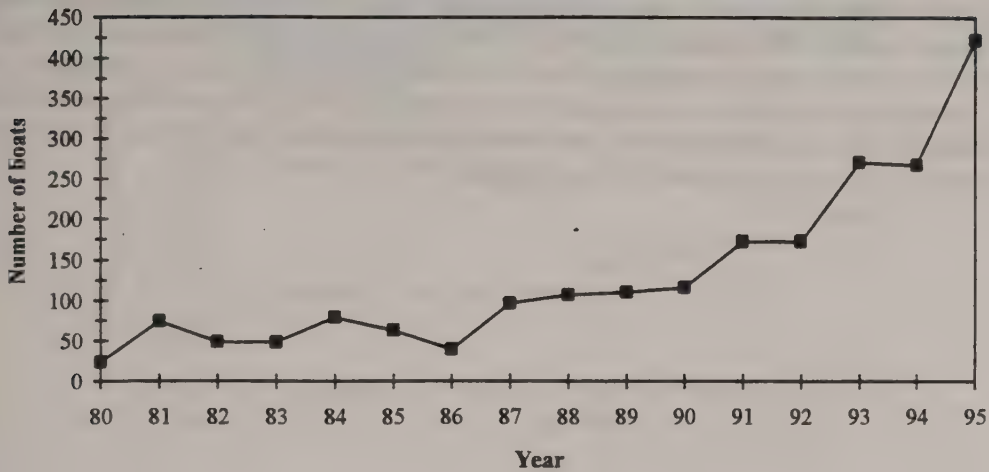
Source: The DAWR creel survey data for bottomfishing methods.

Calculations: The estimated number of boat trips and boat hours for bottomfishing methods are derived directly from the creel survey expansion algorithms.

Interpretations: The almost three-fold increase in 1995 of both total boat hours and boat trips are attributed to the nearly 60% increase in the number of boats, primarily recreational and subsistence, entering into the fishery during the year, and calm seas throughout most of 1995 which enabled many of them to participate in bottomfishing more often than usual. In 1994 there was a 49% reduction in the total number of boat trips and a concomitant 23% drop in the total number of boat hours from the previous year's totals despite increases of approximately

1% in the total BMUS harvest and a dramatic 300% in commercial BMUS catch for the same year (see Figure 2). Contributing to the apparent '94 declines was the extended period of unusually calm seas in late '93 which resulted in an exceptionally high number of boats participating in bottomfishing that year. Thus, the '94 "declines" are somewhat misleading as they could also be considered within the range of a steady and increasing trend in the total number of boat trips and boat hours since 1986. The succession of typhoons and inclement weather that hit Guam between '90 and '92 suppressed the continued trend of a steady and slight increase in the number of boat trips and boat hours from '86 to '94.

Figure 4. Guam bottomfish fishery participation



Year	Number of boats
1980	24
1981	75
1982	49
1983	48
1984	79
1985	63
1986	39
1987	96
1988	107
1989	110
1990	116
1991	173
1992	173
1993	271
1994	268
1995	422
Average	132
Standard deviation	107

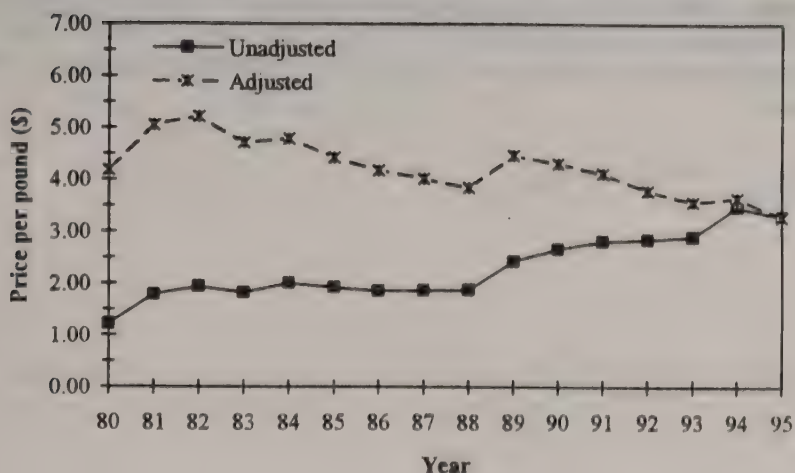
Source: DAWR offshore creel survey data from Agana Boat Basin, Agat Marina and Merizo Pier boat launch sites.

Calculations: The "threshold" C/E model was run a minimum of 15 times per year and the median estimated number of boats is presented above. These numbers should be considered as conservative estimates because boats which use unsurveyed launch sites will never be encountered and because surveys are conducted on only 13% of the possible days.

Interpretations: Over the last several years the number of boats participating in this fishery has increased steadily and continues to grow. The approximately 57% increase between 1992 and 1994 is believed to be the result of an increase in the sampling effort with the inclusion of the

Merizo Pier as a survey site in 1991, a healthy economy that has made it possible for more residents to afford boats, and a return of fair weather that allowed for more favorable fishing conditions. Another 57% increase occurred in 1995 for the same reasons mentioned above, as well as a further increase in sampling effort and islandwide coverage with the addition of the Agat Marina as an offshore creel survey site in October, 1994. Most of the newcomers however, are believed to be recreational- and subsistence-type vessels who bottomfish only part-time and primarily target the shallowwater complex of bottomfish.

Figure 5. Average bottomfish prices



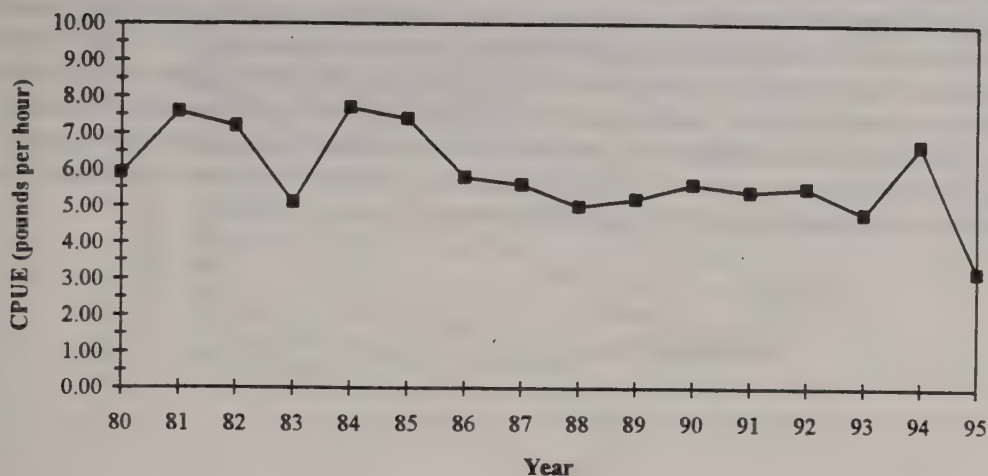
	Unadjusted	Adjusted
Year	\$/lb	\$/lb
1980	1.22	4.19
1981	1.78	5.06
1982	1.93	5.22
1983	1.81	4.72
1984	2.00	4.80
1985	1.91	4.43
1986	1.85	4.18
1987	1.86	4.02
1988	1.87	3.84
1989	2.42	4.47
1990	2.66	4.31
1991	2.81	4.12
1992	2.84	3.79
1993	2.90	3.57
1994	3.47	3.65
1995	3.29	3.29
Average	2.29	4.23
Standard deviation	0.63	0.54

Source: The commercial landings data from the major wholesalers.

Calculations: The average price of all bottomfish species combined is calculated by dividing the total bottomfish revenue by the sold weight. The inflation adjustment is made by using the Consumer Price Index (CPI) for Guam and establishing the 1995 figure as the base from which to calculate expansion factors for all previous years (e.g. divide the 1995 CPI by the CPI for any given year), and then multiplying the unadjusted average price by this factor to obtain the adjusted average price for the given year.

Interpretations: The adjusted average price for bottomfish has not shown consistent marketing trends. This is believed to be the result a seasonal availability of pelagic fish and difficulties in developing a consistent market for locally-caught fish. In addition, imported fish from other islands around the region has contributed to the continued marketing problem for local fishermen.

Figure 6. Guam Bottomfish CPUE



Year	CPUE (lbs/hr)
1980	5.9
1981	7.6
1982	7.3
1983	5.1
1984	7.7
1985	7.5
1986	5.8
1987	5.6
1988	5.0
1989	5.3
1990	5.6
1991	5.4
1992	5.5
1993	4.8
1994	6.7
<u>1995</u>	<u>3.2</u>
Average	5.9
Standard deviation	1.2

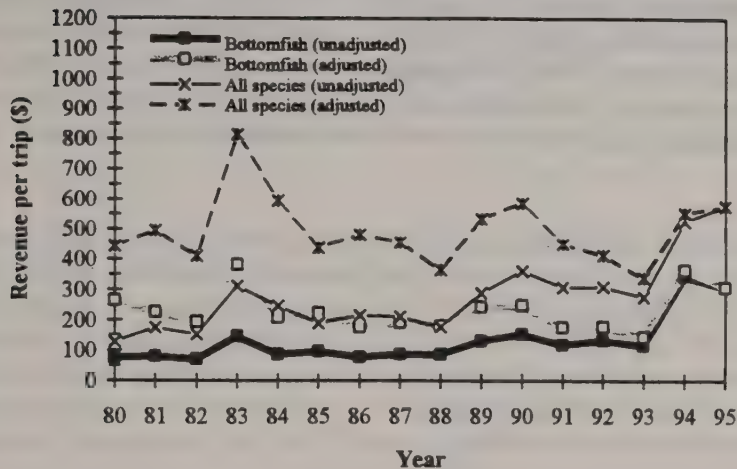
Source: The DAWR creel survey data for the bottom fishing method.

Calculations: The yearly catch-per-unit-effort (CPUE) is calculated by using the year-end survey totals and dividing the total weight of bottomfish landed by the total number of hours spent bottomfishing.

Interpretations: Historically, the annual CPUE has fluctuated around 5 to 8 pounds per hour and has remained fairly stable. The decrease in the CPUE between 1992 and 1993 is most likely due to a reduction in the CPUE of the shallowwater bottomfish complex since most of Guam's recreational and subsistence bottomfishermen target the shallowwater complex. In 1995 the

CPUE fell to an all-time low of 3.2 pounds per hour, owing in large part to an increasing number of recreational- and subsistence-type vessels continuing to enter into the fishery, most of which target the less productive shallowwater complex of bottomfish. Based on an aggregate catch-per-unit effort average of 6.9 pounds per hour for the first three years of data collection on Guam, the 1995 figure places the fishery in a "yellow light" situation for the first time. It is important to note however, that the CPUE is affected considerably, the degree of which has yet to be determined, by the predominance of recreational- and subsistence-type effort that does not target most of the BMUS species of primary concern.

Figure 7. Guam average revenue per trip



Year	<u>\$/Trip (Bottomfish)</u>		<u>\$/Trip (All Species)</u>	
	unadjusted	adjusted	unadjusted	adjusted
1980	77	265	129	443
1981	80	226	174	496
1982	71	193	152	412
1983	147	384	312	815
1984	87	209	248	597
1985	96	223	190	439
1986	78	176	215	484
1987	88	191	212	458
1988	87	180	178	366
1989	132	244	290	536
1990	154	249	363	588
1991	120	176	308	453
1992	134	179	311	415
1993	118	145	277	341
1994	346	364	528	556
1995	307	307	578	578
Average	133	232	279	499
Standard deviation	80	69	126	114

Source: The commercial landings data from major wholesalers.

Calculations: The average revenue per trip for all species is calculated by summing the revenue of all species sold for any trip which landed bottomfish species, and dividing by the number of trips. The average bottomfish revenue per trips is calculated from those same trips by summing the sales of only bottomfish species and dividing by the number of trips.

Interpretations: The inflation-adjusted average revenue per trip does not appear to show any single long-term trends or cause for concern. The increase in the amount of imported bottomfish from around Micronesia (Palau, Chuuk, Pohnpei, etc.) that began sometime

around 1991 with the addition of frequent airline routes to Guam may explain the slight decrease in revenues between 1991 and 1993. The substantial increases in the inflation-adjusted average revenue per trip in 1994 are best explained by the success of the highliner vessels during that year. The 1995 increase in revenue for all species landed versus the decrease in revenue for bottomfish only, indicates that on average, most commercial fishermen continue to make more money from their trolling efforts than from bottomfishing.

Appendix 3

Hawaii

Introduction

The commercial bottomfish stocks in the Hawaiian Islands are divided into two fisheries: seamount groundfish and deep-slope bottomfish. The seamount fishery targets alfonso, *Beryx* spp., and armorhead, *Pseudopentaceros wheeleri*. The only area in the US EEZ for this fishery is Southeast Hancock Seamount located 1,400 nm northwest of Honolulu. This trawl fishery was started by the Russians and Japanese in the late 1960s and large catches were made for about 10 years until they caused a crash in the fishery. This fishery has never been domestically harvested. A moratorium on fishing within the US EEZ began in 1986 and continues through the present as no substantial recovery in the fishery has been observed.

The deep-slope bottomfish fishery in Hawaii concentrates on species of eteline snappers, carangids, and a single species of grouper concentrated at depths of 30-150 fathoms. These fish have been fished on a subsistence basis since ancient times and commercially for at least 90 years. The deep-slope fishing grounds within the US EEZ are divided into three management zones. The inhabited main Hawaiian Islands (MHI) support numerous subsistence, recreational, and commercial fishermen with considerable overlap by category. The uninhabited Northwestern Hawaiian Islands (NWHI) are divided into the Mau Zone, closer to the MHI, and the Hoomalu Zone. Fishing in these zones is conducted solely by commercial fishermen and requires federal licensing for such activities. The Hoomalu Zone is a limited entry zone with 6 vessels participating in 1995; 10 vessels fished the Mau Zone in the same year.

Vessel size varies considerably with larger fully commercial vessels (30 ft in length and over) conducting trips of about 10 days, and smaller vessels (<30 ft) generally restricted to the MHI and trips of 1-3 days. Most vessels in this fishery are fully outfitted with electronic navigation and fish-finding equipment, as well as with electric or hydraulic line-hauling equipment. The catch is sold fresh in the round for local consumption.

Catch and revenue data for bottomfish have been collected by the State of Hawaii Division of Aquatic Resources (HDAR) since 1948 in the form of a report submitted by commercial fishermen. No data is collected for recreational or subsistence fishermen, but their catch is estimated to be about equal to the commercial catch in the MHI. Data obtained from a market monitoring program and data from fishermen interviews are combined with the HDAR data set for the analysis presented in this report.

Summary

The MHI bottomfish fishery has remained relatively stable over the last few years. Landings decreased slightly in 1995 as compared to 1994 despite a marked increase in effort resulting in the lowest CPUE on record for the MHI. Stocks of many of the BMUS species in this zone are stressed. Each of the BMUS species evaluated have a yellow light condition due to a drop in CPUE below 50% of original values. In addition, Onaga, ehu and hapuupuu stocks are recruitment overfished by definition since the SPR values are at or below 20% for these species (6% and 7% for onaga and ehu, respectively, using the targeted CPUE, and 20% for hapuupuu using the aggregate CPUE). These SPR levels are red light conditions demanding immediate action.

Bottomfish stocks in the NWHI appear to remain relatively healthy. CPUE is 42% of the original level in the Mau Zone (a yellow light condition) and 66% in the Hoomalu zone. Analysis of SPR and percent immature in the catch show no problems to date.

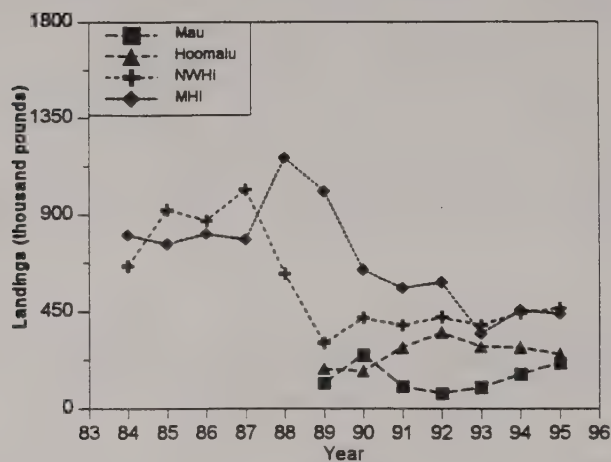
Armorhead stocks outside of the US EEZ experienced a short pulse in recruitment in 1992 which did not carry over into 1993. SPR values at Southeast Hancock Seamount are the highest since 1986, but at 2.5% in 1993 they still indicate a collapsed fishery. Data for 1994 is not available.

Recommendations

- 1) The BPT reiterates its concern regarding the continuing overfished condition of the MHI onaga and ehu stocks as it adds hapuupuu to the list. The Team recommends continued support for the ongoing efforts of the DLNR bottomfish task force toward establishing effective management regulations for the MHI fishery.
- 2) The BPT fully supports the ongoing efforts concerning the recommendations presented in last year's "NWHI Catch Reporting System Review." The Team recommends that: 1) the NMFS Honolulu Laboratory staff assist the State of Hawaii by developing new data processing procedures and algorithms for the newly established HDAR NWHI daily catch logbook and to update previous data; 2) a minimum of three observer bottomfish trips to the NWHI be conducted annually; 3) HDAR establish a procedure to notify the State and Federal fishery enforcement agents for any violations; 4) HDAR provide feedback to the fishermen; and 5) increase the sample size of bottomfish length-frequency data collected on Kauai for the Mau zone.
- 3) Again, the BPT strongly encourages the State to proceed expeditiously with computerization of the fish and seafood dealer reporting system and integrate this with the fishermen's commercial catch reporting system.

4) The BPT strongly encourages NMFS and the State to increase the level of bottomfish catch monitoring of the Honolulu auction and expand this sampling to major dealers on all other main Hawaiian Islands.

Figure 1. Hawaii's bottomfish landings from the NWHI and MHI



Year	Landings (1000 lb)			
	Mau	Hoomalu	Total NWHI	MHI ²
1984	NA	NA	661	807
1985	NA	NA	922	763
1986	NA	NA	869	810
1987	NA	NA	1015	783
1988	NA	NA	625	1164
1989	118	184	303	1006
1990	249	173	421	645
1991 ¹	103	283	387	561
1992 ¹	71	353	424	587
1993 ¹	98	287	385	348
1994 ¹	160	283	443	458
1995	210	253	464	440

¹ NWHI data from combination of NMFS and HDAR

² MHI data from HDAR

Source: Data from a combination of HDAR and NMFS market monitoring program.

Calculation & Adjustment: NMFS monitoring data was supplemented with all additional NWHI trips from the HDAR fast-track system. The majority of the Kauai-based (Mau zone) segment of the NWHI fishing fleet was added from the HDAR data. Use of the data sets in combination provides good coverage of the activities of the NWHI bottomfish fleet. It also provides opportunities for the cross-checking of trip and landing information. MHI landings are simple totals from HDAR commercial catch reports, and do not include any expansion for unreported recreational landings.

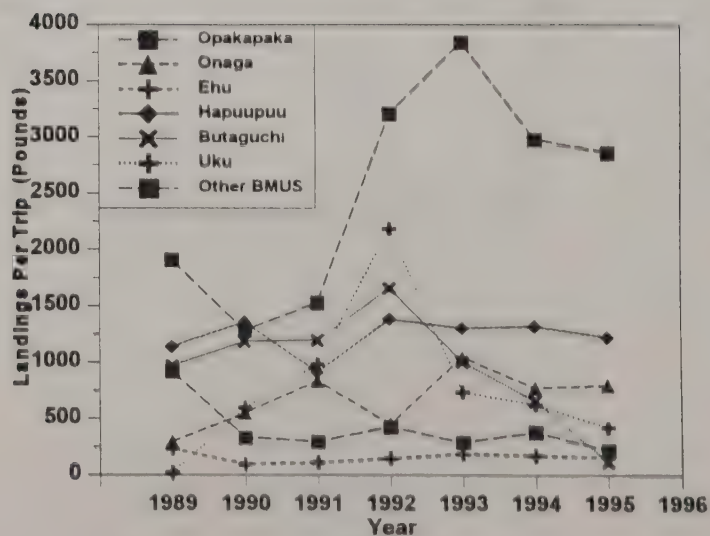
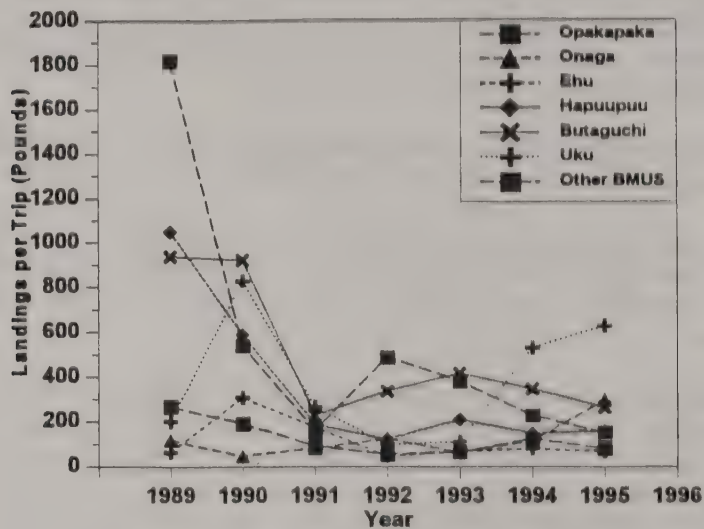
Comments & Interpretation: Overall NWHI landings are the highest they have been since 1988. Mau zone landings have risen 31% while the Hoomalu zone landings have declined by 10%.

Mau zone landings have continued to rise steadily since Hurricane Iniki in 1992. Landings have rebounded to nearly pre-hurricane levels as the NWHI Mau zone fleet based on Kauai have re-entered the fishery. The addition of a new full-time vessel from Maui in 1994 has also greatly contributed to the increase in Mau zone landings.

Hoomalu zone landings have continued to decline since 1992. Landings were down for nearly all of the BMUS. One explanation for the apparant decrease in 1995 is that one of the top producing vessels has recently been experimenting with catching sharks. The high number of interactions with sharks during bottomfishing operations and the high value of their fins has provided the impetus for this experiment. The result is reduced bottomfishing effort which in turn reduces the catch of bottomfish species. There were 3 other vessels that fished on a less than full-time basis and which did not make large volume landings. The less than full-time effort by these vessels may have been part of the reason for the apparant decline of the landings.

Main Hawaiian Island landings were down slightly from 1994 in spite of increased effort.

Figure 2. Northwestern Hawaiian Islands BMUS species composition of landings per trip, by weight, for the Mau and Hoomalu Zones



NWHI BMUS average pounds per trip by species, Mau Zone

Species	1989	1990	1991 ¹	1992 ¹	1993 ¹	1994 ¹	1995
Opakapaka	1820	541	163	488	382	229	153
Onaga	120	49	83	124	66	114	297
Ehu	65	309	176	48	69	81	69
Hapuupuu	1050	590	189	121	210	150	160
Butaguchi	938	923	228	336	415	346	263
Uku	202	830	266	100	112	529	628
Other BMUS	268	193	94	56	67	124	84
Total per trip	4463	3435	1199	1273	1321	1573	1656

¹ Data from combination of NMFS and HDAR data sets.

NWHI BMUS average pounds per trip by species, Hoomalu Zone

Species	1989	1990	1991 ¹	1992 ¹	1993 ¹	1994 ¹	1995
Opakapaka	1910	1284	1530	3208	3849	2984	2859
Onaga	293	550	837	450	1042	771	796
Ehu	231	94	113	148	185	172	156
Hapuupuu	1138	1357	913	1386	1305	1318	1222
Butaguchi	969	1185	1196	1660	1004	655	114
Uku	20	600	985	2187	736	623	419
Other BMUS	920	333	297	425	291	380	221
Total per trip	5481	5403	5871	9464	8412	6903	6389

¹ Data from combination of NMFS and HDAR data sets.

Source: Data from a combination of HDAR and NMFS market monitoring program

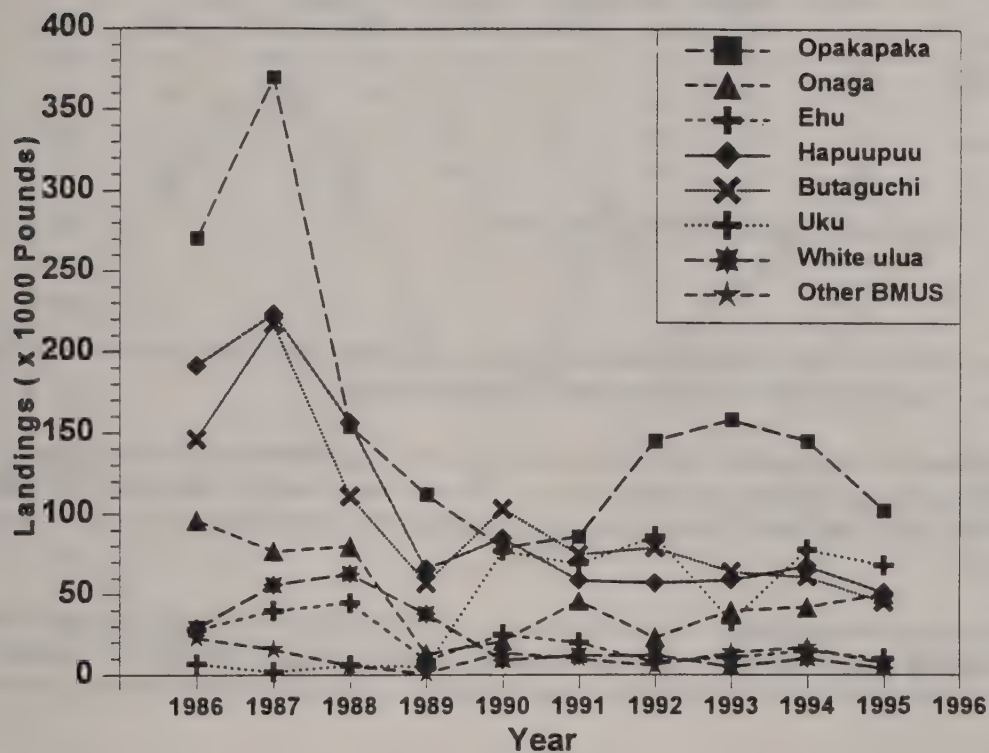
Calculation & Adjustment: NMFS monitoring data was supplemented with all additional NWHI trips from the HDAR fast-track system. The BMUS data were totaled by zone and divided by the number of trips to each zone. The 1994 NWHI data, which were preliminary estimates in the 1994 annual report, have been updated.

Comments & Interpretations: Mau zone landings of BMUS species has been steadily rising since 1992. Onaga catches have increased by 183 pounds per trip and are the highest they have been in over 6 years. Uku catches account for the largest single species per trip catch (nearly

38%) and is the highest since the run in 1990. Species composition from trip report data indicate that many of the Kauai-based vessels targeted uku over any other species. This may be a reflection of the abundance/availability of this species as the Kauai based vessels made short trips to the area.

Hoomalu zone landings have been slowly declining after the uku run in 1992. The 1995 BMUS catch per trip has declined for all species with the exception of onaga. Although 6 vessels did participate in the fishery only 3 of them did so on a full-time basis. One of the full-time vessels did decrease its bottomfish effort due to starting an experimental shark fishery while on bottomfishing trips.

Figure 3. NWHI BMUS species composition of landings by weight



Species	1986	1987	1988	1989	1990	1991 ¹	1992 ¹	1993 ¹	1994 ¹	1995
Opakapaka	270	370	154	112	79	86	145	158	145	102
Onaga	96	77	80	13	21	46	23	40	42	50
Ehu	28	40	45	9	25	20	8	11	15	10
Hapuupuu	191	223	156	66	85	59	57	59	68	51
Butaguchi	146	217	111	57	103	75	79	64	61	45
Uku	7	2	6	5	77	69	86	33	78	68
White ulua	29	56	63	38	9	12	12	5	10	4
Other	23	16	6	1	14	10	6	14	17	7
BMUS										

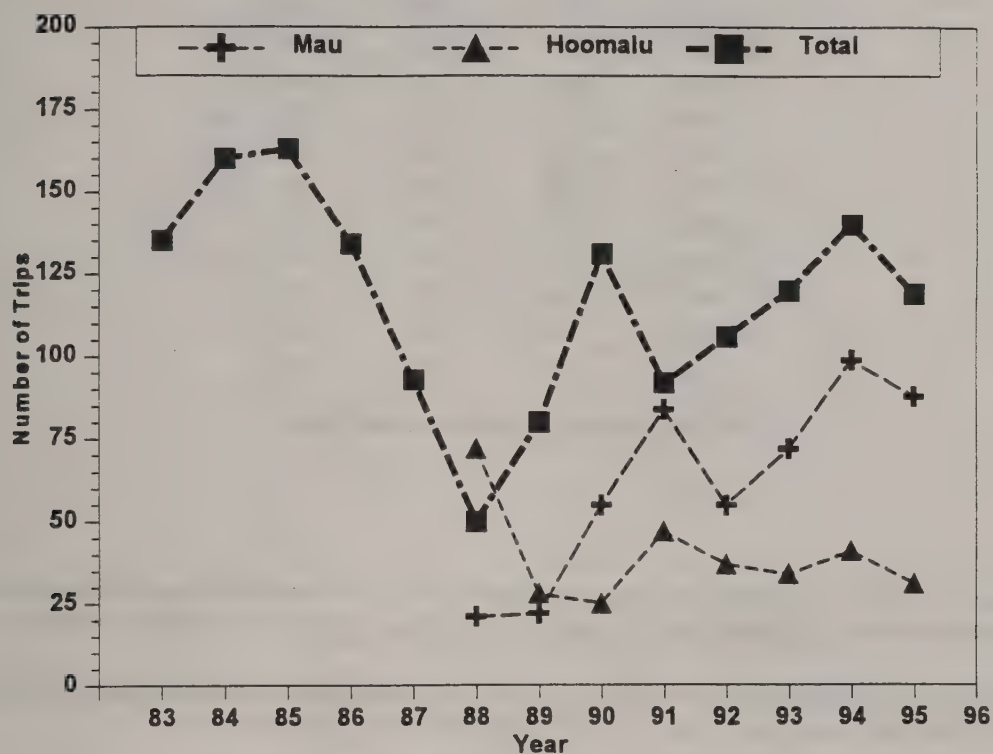
¹ Data from a combination of NMFS and HDAR data.

Source: Data for 1991-1995 are from a combination of HDAR and NMFS market monitoring program. Data from 1987-1990 are expanded NMFS estimates.

Calculation & Adjustment: NMFS monitoring data was supplemented with all additional NWHI trips from the HDAR fast-track system. The data were totaled by species for the BMUS. The 1994 NWHI data, which were preliminary estimates in the 1994 annual report, have been updated.

Comments & Interpretation: The overall landing trends of the NWHI bottomfish fishery are shown in this figure. There is a general trend of decreasing landings for the BMUS. Opakapaka landings show the largest decline while onaga was the only species to show an increase in 1995.

Figure 4. Number of trips made by NWHI bottomfish fleet, Mau and Hoomalu Zones



Year	Trips		
	Mau	Hoomalu	Total
1984	NA	NA	135
1985	NA	NA	160
1986	NA	NA	163
1987	NA	NA	134
1988	21	72	93
1989	22	28	50
1990	55	25	80
1991 ¹	84	47	131
1992 ¹	55	37	92
1993 ¹	72	34	106
1994 ¹	99	41	140
1995	88	31	119

¹ Based on combined NMFS and HDAR data.

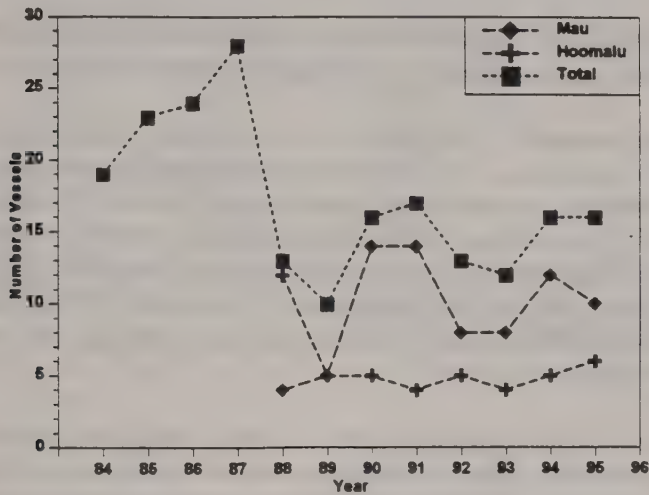
Source: Data for 1991-1995 are from a combination of HDAR and NMFS market monitoring program and the HDAR fast-track data system. Data from 1986-1990 are NMFS estimates.

Calculation & Adjustment: NMFS trip data was supplemented with all additional NWHI trips from the HDAR fast-track system. The trips were totaled by area fished.

Comments & Interpretation: The overall trend in the number of trips to the NWHI areas has decreased this year. The number of vessels fishing in the access restricted Hoomalu zone has remained relatively constant at 4-6 vessels per year since 1989 when the limited entry plan went into effect. The decrease in the number of trips to the Hoomalu zone in 1995 is probably due to the fact that only 3 of the 6 vessels fished on a full-time basis. The average number of trips per vessel dropped to 5 after averaging 8 for the 1993-1994 season.

The number of trips to the Mau zone also dropped in 1995 but remains above those of the 1989-1993 seasons. The number of trips have rebounded after the low point in 1992 after Hurricane Iniki. Additional trip data from HDAR beginning in 1991 has enhanced the accuracy of the data. Trips by the Mau zone fleet home-ported on Kauai are more easily monitored using the HDAR fast-track system. Many of these were previously missed using only the NMFS market monitoring system.

Figure 5. Number of vessels in the NWHI bottomfish fleet, Mau and Hoomalu Zones



Year	Boats		
	Mau	Hoomalu	Total ²
1984	NA	NA	19
1985	NA	NA	23
1986	NA	NA	24
1987	NA	NA	28
1988	4	12	13
1989	5	5	10
1990	14	5	16
1991 ¹	14	4	17
1992 ¹	8	5	13
1993 ¹	8	4	12
1994 ¹	12	5	16
1995	10	6	16

¹ Based on a combination NMFS and HDAR data set.

² Total may not match sum of areas due to vessel participation in multiple areas.

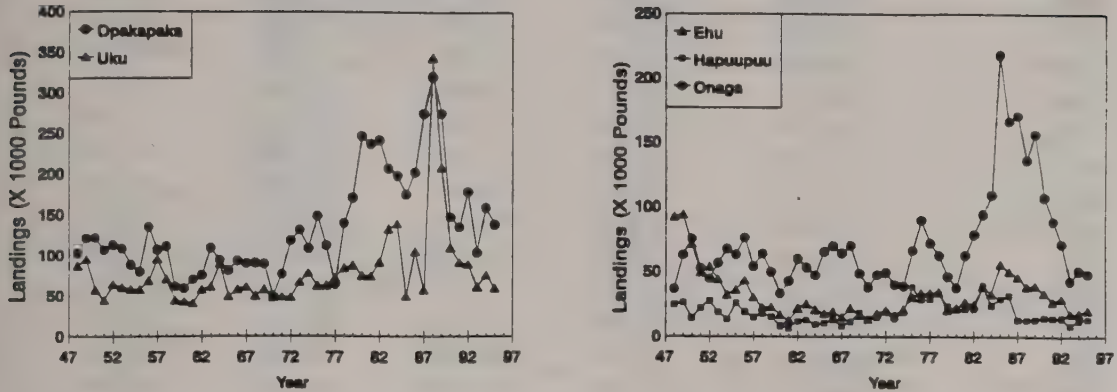
Source: Data for 1991-1995 are from a combination of HDAR and NMFS market monitoring program and the HDAR fast-track data system. Data from 1984-1990 are NMFS estimates.

Calculation & Adjustment: NMFS vessel data was supplemented with all additional NWHI vessels from the HDAR fast-track system. The number of vessels were totaled by area fished.

Comments & Interpretation: The overall trend in the number of vessels fishing in the NWHI areas has remained level this year. The number of vessels fishing in the access restricted Hoomalu zone has remained relatively constant at 4-6 vessels per year since 1989 when the limited entry plan went into effect. There was speculation that the number of vessels would rise in 1995 due to the effect of the grandfather time period coming to a close at the end of 1994 which would promote the last chance entry of these "grandfathers". In fact the level of participation would have increased by 3 additional vessels which ultimately did not fish the 1995 season. They may subsequently enter the fishery in 1996.

The Mau zone has been the more dynamic zone in terms of vessel participation. The open access designation has allowed many vessels to acquire permits and fish this area. The number of vessels in the Mau zone also dropped in 1995 but still remains within the range of 8-12 vessels per year. Additional vessel data from HDAR beginning in 1991 has enhanced the accuracy of the data. The Mau zone fleet home-ported on Kauai are easily identified and monitored using the HDAR fast-track system. Many of these were previously missed using only the NMFS market monitoring system.

Figure 6. MHI species composition of landings by weight



Source: Total commercial landings by species are from HDAR commercial catch report data.

Comments: Does not include any expansion for recreational landings. The values for 1994 and 1995 are preliminary estimates.

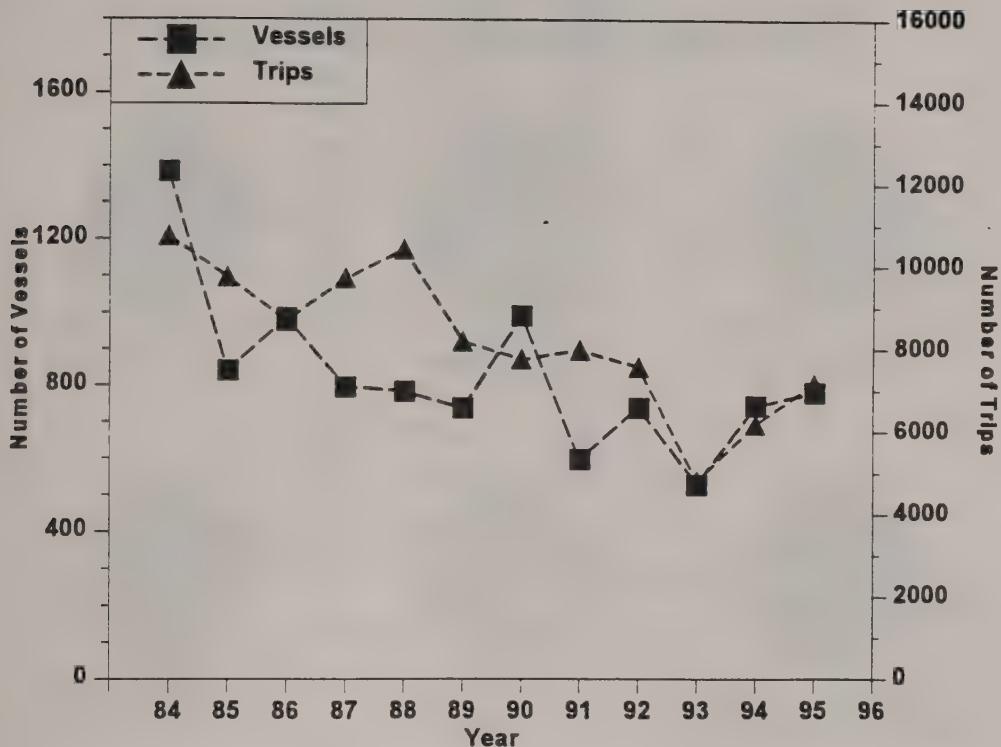
Interpretation: Most species show declining trends continuing from the mid- and late-eighties. The prevailing interannual pattern in landings is episodic versus predictably periodic or constant.

MHI Landings by Species

Year	OPA	UKU	EHU	HAP	ONA
1948	102,651	87,235	92,323	24,609	36,804
1949	121,243	95,273	94,097	26,397	62,979
1950	121,664	57,814	71,286	14,514	75,398
1951	106,423	45,065	49,699	22,000	53,018
1952	112,917	64,799	53,716	27,499	44,604
1953	108,504	61,619	44,200	19,009	56,506
1954	88,641	58,767	32,278	13,367	67,583
1955	80,516	58,564	36,017	25,849	63,208
1956	134,980	69,108	43,313	19,224	75,986
1957	106,656	95,267	30,157	14,782	53,988
1958	111,131	71,321	22,309	18,033	63,774
1959	62,043	44,705	23,107	15,294	49,745
1960	59,405	43,186	16,950	8,418	33,158
1961	70,083	41,134	12,370	6,642	42,701
1962	75,492	57,568	21,742	11,663	59,788
1963	108,505	61,601	25,267	12,865	53,225

1964	93,618	89,156	20,914	9,321	47,325
1965	81,039	49,485	17,605	10,297	65,040
1966	92,815	57,849	19,342	13,277	69,634
1967	89,364	60,970	14,899	8,480	64,022
1968	89,908	49,677	21,984	11,287	69,922
1969	88,621	57,542	16,483	18,300	48,454
1970	49,655	47,443	13,364	13,651	37,894
1971	76,388	48,710	17,626	14,746	47,250
1972	117,367	48,077	20,347	18,994	49,213
1973	130,785	66,875	16,336	13,878	39,811
1974	107,828	77,939	21,015	18,874	38,883
1975	147,755	62,117	30,155	38,140	66,029
1976	111,520	62,165	33,788	28,214	89,518
1977	163,813	71,915	33,689	28,540	71,747
1978	138,931	83,798	34,333	33,271	62,208
1979	170,180	87,128	20,339	23,538	46,271
1980	247,378	74,782	21,712	20,962	37,489
1981	237,254	73,921	26,900	21,178	62,351
1982	241,977	90,793	24,542	21,263	78,372
1983	207,345	131,860	38,793	39,447	94,082
1984	198,260	138,313	33,022	24,019	109,046
1985	174,746	49,264	56,039	29,055	218,552
1986	202,467	104,047	50,259	31,626	167,112
1987	274,929	56,753	46,018	13,232	171,416
1988	320,601	344,128	38,547	12,838	136,641
1989	275,167	208,171	39,393	12,954	156,952
1990	146,861	108,840	33,848	14,934	107,514
1991	134,326	90,272	26,902	14,216	88,978
1992	178,014	88,474	29,461	14,454	71,715
1993	102,514	60,910	17,981	8,593	43,141
1994	158,276	72,133	18,000	12,712	51,502
1995	137,473	59,036	20,689	13,819	48,948

Figure 7. Standardized MHI bottomfishing trips & vessels



Source: Fishing effort and vessels estimates based on commercial HDAR C-3 catch report data.

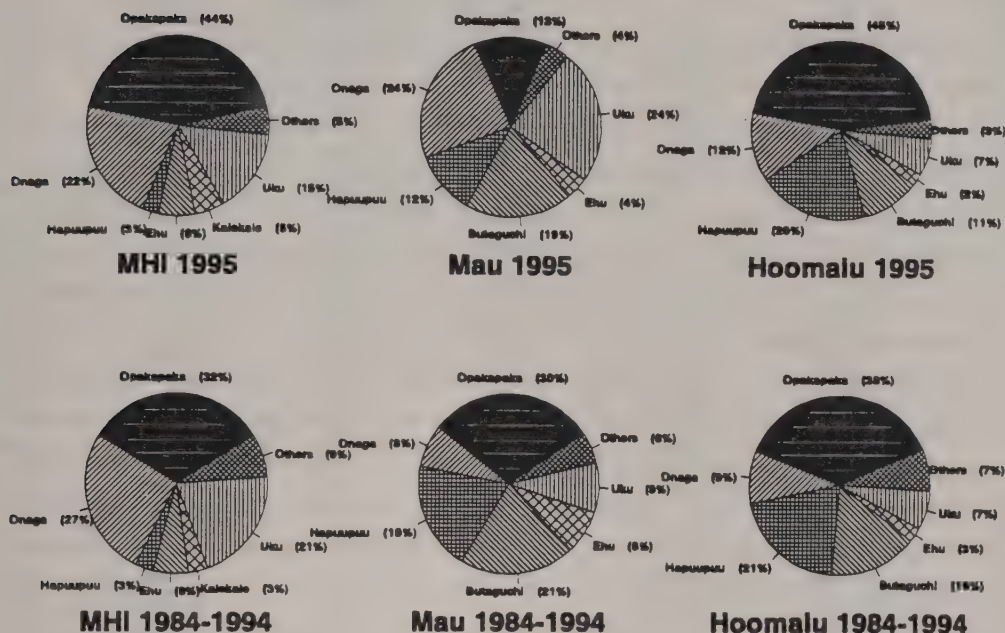
Calculation & Adjustment: MHI trips and vessels estimated from annual total MHI bottomfish landings, mean CPUE, and mean total landings per vessel. These estimates represent standardized units of Maui-Molokai-Lanai-Kahoolawe (MLMK) bottomfishing trips and vessels as applied to the entire MHI region. The MLMK criteria for MHI CPUE are described in Fig. 14-A. All values have changed slightly from previous year's reports due to modifications in the calculation. A preliminary expansion factor is used to estimate unreported recreational landings (from Hamm and Lum, 1992). Effort estimates are based on calendar year and are essentially complete for 1995 whereas the participation estimates are based on fiscal year (due to the need to track individual license numbers) and are incomplete for 1995.

Interpretation: Effort and participation in the MHI fishery continues to increase in 1995.

Year	Trips	Vessels
1984	10,769	1,386
1985	9,747	841
1986	8,682	985
1987	9,719	797
1988	10,415	785
1989	8,190	739
1990	7,764	992
1991	7,991	601
1992	7,574	742
1993	4,647	532
1992	7,574	742
1993	4,813	532
1994	6,190	747
1995	7,182	784

Figure 8. Current year and historical catch composition by weight in sold catch.

Percent by weight in catch sold at Honolulu auction



Source: Catch composition estimated from Honolulu auction data.

Comments: Reflects only auction-sold fish, and does not include fish that are kept, given away, or sold at other locations. "Others" in the MHI include butaguchi, gindai, white ulua, lehi, and taape. "Others" in the NWHI include kalekale, gindai, white ulua, lehi, and taape.

Interpretation: The 1995 pattern closely resembles the historical pattern in the MHI and Hoomalu zone. Mau zone onaga became a larger component of the catch in 1995.

Table 9. Hawaii Bottomfish Revenue, adjusted for inflation, 1970-present.

Year	Total Pounds (1,000)	Total Revenue (\$1,000)	Inflation- adjusted Revenue (\$1,000)	Average Price per Pound	Inflation- adjusted Average Price per Pound	Honolulu Consumer Price Index
1970	344	\$253	\$1,035	\$0.74	\$3.01	114
1971	410	312	1,226	\$0.76	\$2.99	119
1972	407	366	1,392	\$0.90	\$3.42	123
1973	454	418	1,522	\$0.92	\$3.35	128
1974	413	421	1,386	\$1.02	\$3.36	142
1975	544	577	1,739	\$1.06	\$3.19	155
1976	558	693	1,988	\$1.24	\$3.56	163
1977	562	764	2,077	\$1.36	\$3.70	172
1978	740	1,100	2,791	\$1.49	\$3.77	184
1979	809	1,296	2,959	\$1.60	\$3.66	205
1980	856	1,218	2,488	\$1.42	\$2.91	229
1981	993	1,794	3,314	\$1.81	\$3.34	253
1982	1,162	2,177	3,793	\$1.87	\$3.27	268
1983	1,422	3,228	5,465	\$2.27	\$3.84	276
1984	1,464	3,147	5,161	\$2.15	\$3.53	285
1985	1,687	3,754	5,818	\$2.23	\$3.45	301
1986	1,680	3,952	5,990	\$2.35	\$3.57	308
1987	1,818	4,687	6,761	\$2.58	\$3.72	324
1988	1,794	4,796	6,530	\$2.67	\$3.64	343
1989	1,314	3,861	5,067	\$2.94	\$3.86	356
1990	1,092	3,375	4,145	\$3.09	\$3.80	380
1991	983	2,811	3,187	\$2.86	\$3.24	412
1992	1,043	3,154	3,410	\$3.02	\$3.27	432
1993	862	2,745	2,875	\$3.18	\$3.34	446
1994	1,005	3,254	3,304	\$3.24	\$3.29	460
1995	832	2,579	2,579	\$3.10	\$3.10	467

Data: Hawaii Division of Aquatic Resources (HDAR) commercial catch reports are utilized for all Main Hawaiian Islands (MHI) landings and revenue. HDAR reports are also used for pre-1984 Northwestern Hawaiian Islands (NWHI) landings. NWHI landings since 1984 are from the NMFS Honolulu Laboratory's fishery monitoring program. *Total* Hawaii landings may not equal MHI + NWHI due to domestic bottomfish landings in Hawaii from "Other" areas. "Other" areas include various U.S. possessions in the central Pacific (e.g., Palmyra), as well as landings where the area was not recorded.

Revenue is adjusted for inflation by the ratio of the Honolulu Consumer Price Index (HCPI) for the current year (1995) to each year in the time series.

Interpretation: The data show that *real* (inflation-adjusted) revenue peaked in 1987 and has declined by over 50% since then. The mid- to late-1980s were also the recent period of highest inflation-adjusted aggregate average prices. Previous economic research (mid-1980s) showed a considerable relationship between price and volume, but this relationship appears to have faltered and the market for Hawaii bottomfish appears weaker, perhaps due to an increase in imported bottomfish from South Pacific island nations.

Data source: N8795B.cal (7/17/96) & HTOT95A.cal (7/17/96)

Hawaii Bottomfish Landings & Revenue*

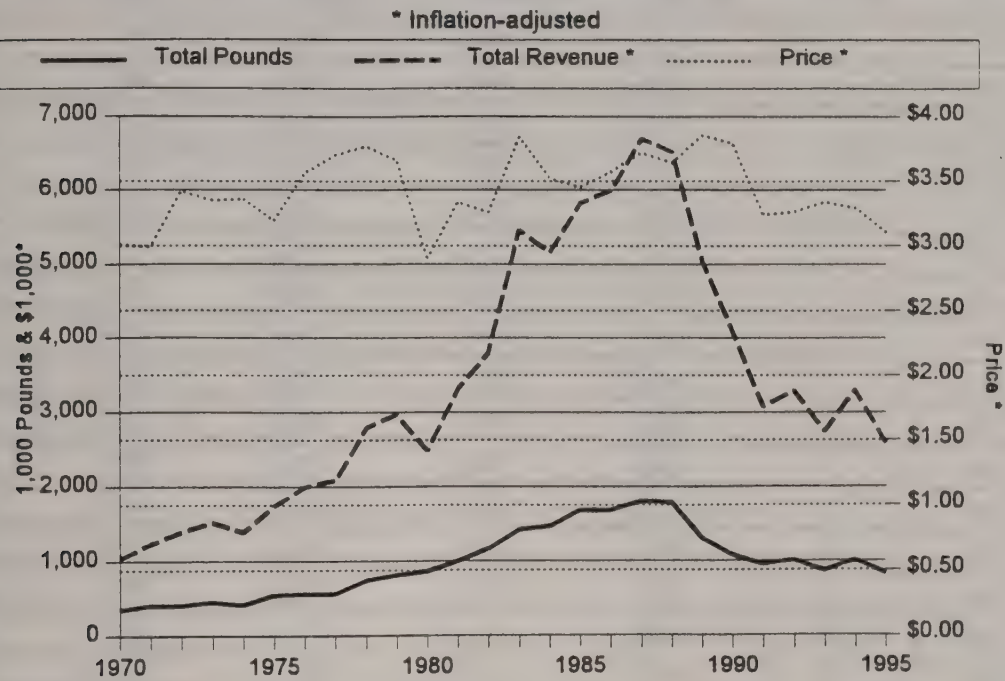


Table 10: Hawaii Bottomfish Revenue* by Source, 1970-present (* Inflation-adjusted)

Year	NWHI (\$1,000)	MHI (\$1,000)	NWHI * (\$1,000)	MHI * (\$1,000)	HCPI
1970	39	214	160	877	114
1971	50	262	196	1,029	119
1972	42	324	160	1,232	123
1973	63	355	229	1,292	128
1974	49	372	161	1,224	142
1975	64	513	193	1,546	155
1976	78	615	224	1,764	163
1977	104	660	283	1,794	172
1978	194	906	492	2,298	184
1979	356	940	812	2,147	205
1980	299	919	611	1,877	229
1981	611	1,183	1,128	2,185	253
1982	685	1,492	1,193	2,599	268
1983	1,346	1,882	2,278	3,186	276
1984	1,350	1,797	2,214	2,947	285
1985	1,800	1,954	2,789	3,028	301
1986	1,900	2,052	2,879	3,109	308
1987	2,300	2,345	3,317	3,382	324
1988	1,500	3,288	2,042	4,476	343
1989	750	3,090	984	4,055	356
1990	1,070	2,265	1,314	2,781	380
1991	1,000	1,713	1,133	1,942	412
1992	1,210	1,842	1,308	1,991	432
1993	1,170	1,535	1,225	1,607	446
1994	1,357	1,794	1,378	1,821	460
1995	1,025	1,549	1,025	1,549	467

Table 10a: Landings associated with revenue tables, 1970-present

Year	Total ¹	MHI	NWHI
1970	344	270	74
1971	410	335	75
1972	407	364	43
1973	454	392	62
1974	413	364	49
1975	544	485	59
1976	558	499	59
1977	562	479	83
1978	740	597	143
1979	809	580	229
1980	856	541	316
1981	993	591	402
1982	1,162	673	488
1983	1,422	847	575
1984	1,464	803	661
1985	1,687	765	922
1986	1,680	811	869
1987	1,819	785	1,015
1988	1,795	1,166	625
1989	1,314	1,007	303
1990	1,092	652	421
1991	983	562	387
1992	1,043	587	424
1993	862	463	385
1994	1,005	537	436
1995	834	493	337

¹ Total may not equal MHI + NWHI due to landings from "Other" areas, i.e., from distant-water fishing vessels landing in Honolulu.

Data: Hawaii Division of Aquatic Resources (HDAR) commercial catch reports are utilized for all Main Hawaiian Islands (MHI) landings and revenue. HDAR reports are also used for pre-1984 Northwestern Hawaiian Islands (NWHI) landings. NWHI landings since 1984 are from the NMFS Honolulu Laboratory's fishery monitoring program. *Total* Hawaii landings may not equal MHI + NWHI due to domestic bottomfish landings in Hawaii from "Other" areas.

Interpretation: The data show that the rise in revenue (adjusted for inflation) to their peaks in 1985-1988 was from both the development of the Northwestern Hawaiian Islands in the early 1980s and the growth of the Main Hawaiian Islands fishery. Both MHI and NWHI inflation-adjusted revenues are now less than a third what they were in 1988.

Data source: N8795B.cal (7/15/96) & HTOT95A.cal (7/19/96)

Hawaii Bottomfish Revenue* By Source

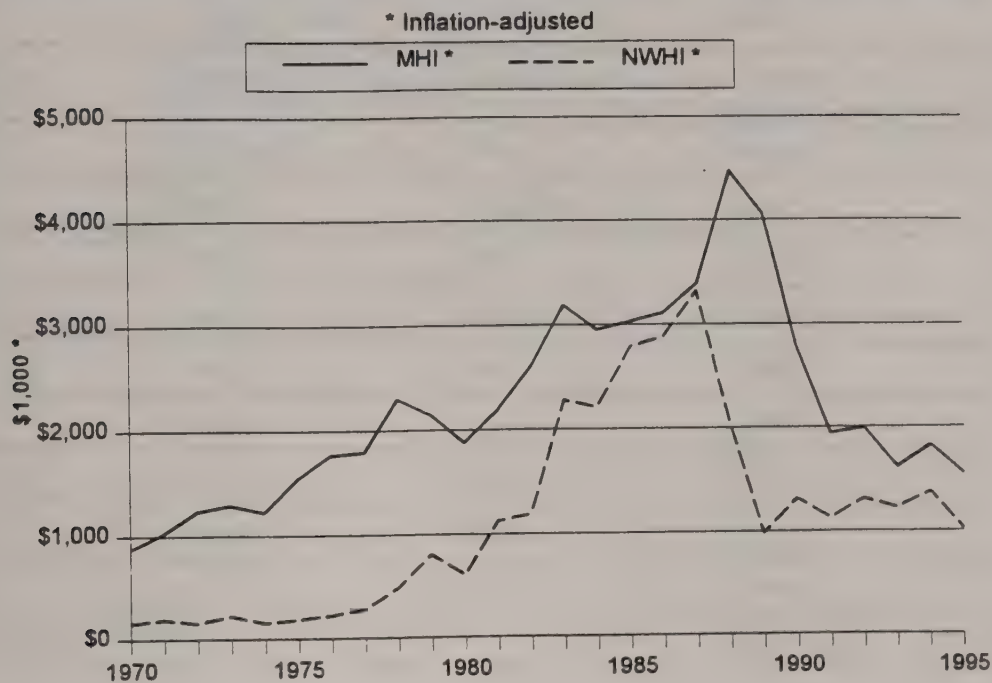


Table 11a: Hawaii Bottomfish Prices by Source, 1987-present
(Prices not adjusted for inflation)

Year	Total Hawaii	MHI	NWHI
1987	\$2.58	\$2.97	\$2.27
1988	\$2.67	\$2.82	\$2.40
1989	\$2.94	\$3.08	\$2.48
1990	\$3.09	\$3.44	\$2.54
1991	\$2.86	\$3.04	\$2.58
1992	\$2.61	\$2.45	\$2.85
1993	\$3.18	\$3.32	\$3.01
1994	\$3.24	\$3.34	\$3.11
1995	\$3.10	\$3.14	\$3.04

Data: MHI prices are compiled from HDAR commercial catch reports. NWHI prices are compiled from NMFS market monitoring. *Total* Hawaii prices are a weighted average of MHI & NWHI revenue and pounds landed (not necessarily pounds sold).

Interpretation: The price figures show the continued preference for main Hawaiian Islands bottomfish on average, although species composition may affect the year-to-year change in weighted averages. As shown in a subsequent table, average prices for all species landed from the MHI exceed those landed from the NWHI. This is largely due to freshness and market size preferences. Imports of bottomfish from South Pacific island areas are believed to be playing a larger role in the Hawaii market, but recent figures were not available at the time of preparation of this module.

Data source: N8795B.cal

Hawaii Bottomfish Prices by Source

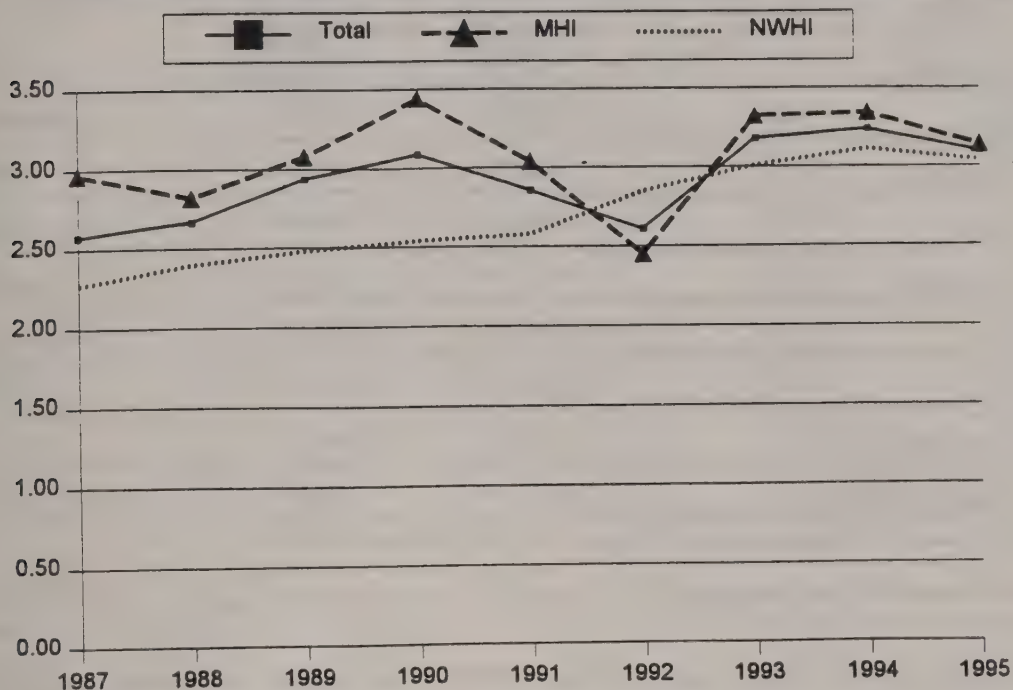


Table 11b: Hawaii Bottomfish Species Prices, 1994 & 1995

Species	1994	1995
Butaguchi	\$1.76	\$1.96
Ehu	\$3.86	\$3.58
Hapuupuu	\$2.85	\$3.53
Onaga	\$5.60	\$4.90
Opakapaka	\$3.97	\$3.65
Uku	\$2.83	\$2.81
Ulua	\$1.18	\$1.53
Other BMUS	\$1.40	\$1.30
Other Bottomfish	\$1.79	\$1.87
Total	\$3.24	\$3.10

Data: Hawaii Division of Aquatic Resources (HDAR) commercial catch reports are utilized for all Main Hawaiian Islands (MHI) landings and revenue. HDAR reports are also used for pre-1984 Northwestern Hawaiian Islands (NWHI) landings. NWHI landings since 1984 are from the NMFS Honolulu Laboratory's fishery monitoring program. Data are combined to provide Hawaii totals. *Total* Hawaii prices are a weighted average of MHI & NWHI revenue and pounds landed (not necessarily pounds sold). *Other BMUS* are other Bottomfish Management Unit Species.

Interpretation: The data show increased prices in 1995 for several previously secondary species (e.g., *butaguchi* and *ulua*), perhaps demonstrating the effect of the State's aggressive market promotion of these species. However primary species, *Opakapaka* and *Onaga*, have weakened prices in 1995. The cause for this decline may be attributable to the weakened tourist economy in 1995.

Data source: N8795B.cal (7/15/96)

Table 11c: MHI & NWHI Bottomfish Species Prices, 1994 & 1995

Species	1994		1995	
	MHI	NWHI	MHI	NWHI
Butaguchi	\$1.93	\$1.72	\$2.75	\$1.87
Ehu	\$4.25	\$3.35	\$4.04	\$2.39
Hapuupuu	\$3.34	\$2.83	\$3.64	\$3.50
Onaga	\$6.47	\$4.56	\$5.90	\$3.63
Opakapaka	\$3.92	\$3.98	\$3.78	\$3.44
Uku	\$2.98	\$2.66	\$2.81	\$2.80
Ulua	\$1.09	\$1.20	\$1.29	\$1.70
Other BMUS	\$1.40	\$1.27	\$1.30	\$1.30
Other Bottomfish	\$1.79	na	\$1.87	na
Total Bottomfish	\$3.34	\$3.11	\$3.14	\$3.04

Data: MHI prices are compiled from HDAR commercial catch reports. NWHI prices are compiled from NMFS market monitoring.

Interpretation: The price figures show the preference for main Hawaiian Islands bottomfish. Prices for all species landed from the MHI exceed those landed from the NWHI. This is largely due to freshness and market size preferences.

Data source: N8795B.cal

Table 12: NWHI Bottomfish Inflation-adjusted Revenue per Trip, 1984-present

Year	Inflation-adjusted Revenue (\$1,000)	Trips	Inflation-adjusted Revenue per Trip (\$)
1984	2,214	135	\$16,400
1985	2,789	160	\$17,431
1986	2,879	163	\$17,663
1987	3,317	134	\$24,754
1988	2,042	93	\$21,957
1989	984	50	\$19,680
1990	1,314	80	\$16,425
1991	1,133	131	\$8,649
1992	1,308	92	\$14,217
1993	1,225	106	\$11,557
1994	1,378	140	\$9,843
1995	1,025	119	\$8,613

Data: Data are compiled from previous tables in this report, based on NMFS monitoring of NWHI bottomfish landings.

Interpretation: Interpretation of the revenue per trip must be couched in terms of potentially changing composition of the trips between Ho'omalu and Mau zone participation. In the early years, Mau zone trips comprised only 20-25% of all NWHI bottomfish trips; in 1995 they comprised almost 75%. Since Mau zone vessels are smaller, and their trips are briefer in duration, it would be expected that aggregate revenue per trip would decline. This does not indicate whether revenue per trip for either zone changed over the 12 year time span.

NWHI Revenue per Trip

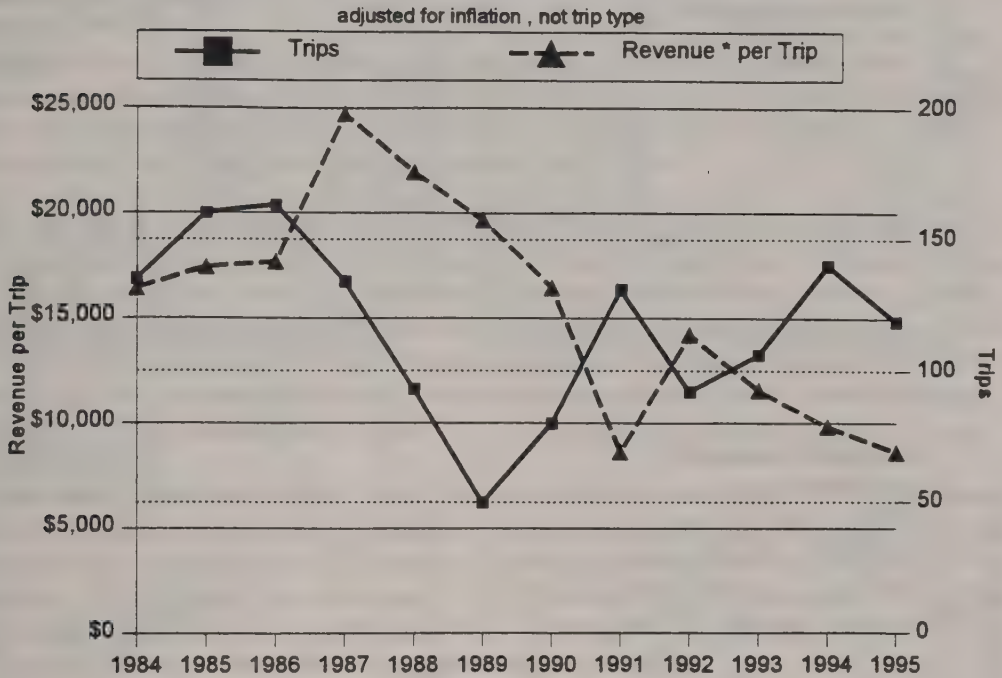
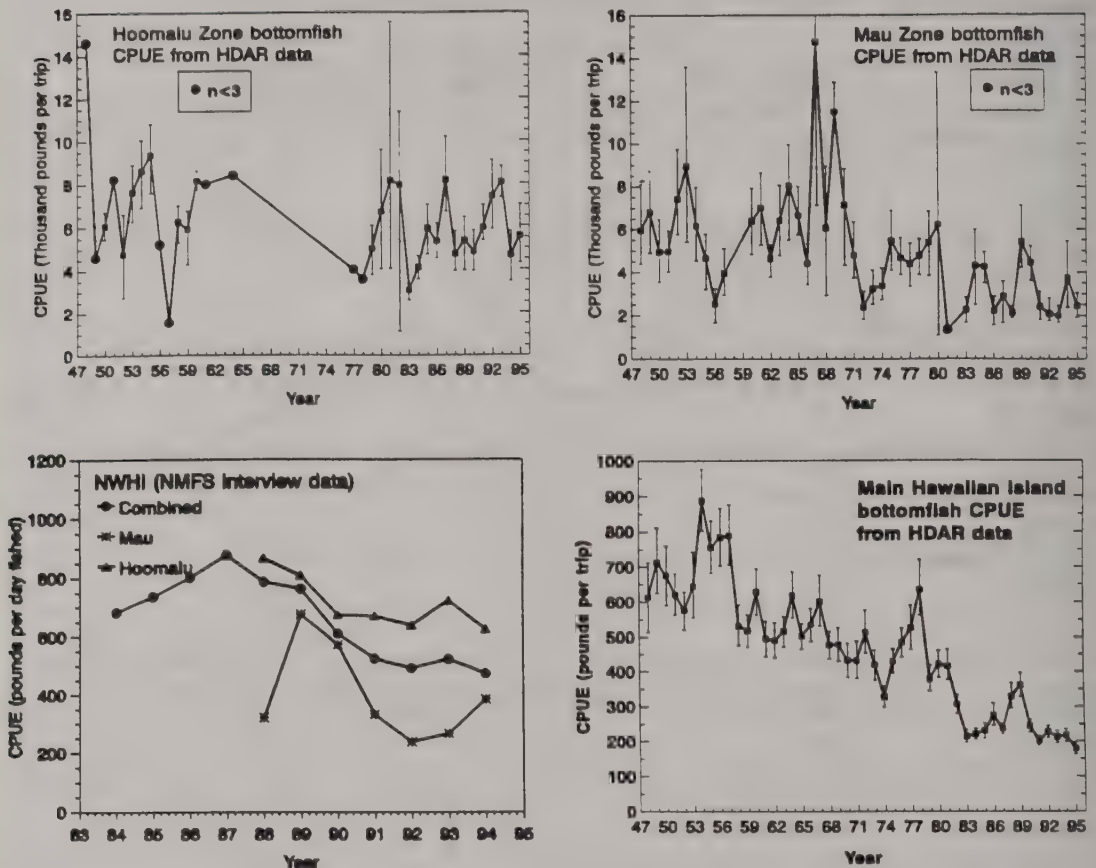


Figure 14-A. CPUE for Hawaiian bottomfish



Source: MHI CPUE is based on HDAR C-3 catch report data from commercial fishermen. Two NWHI CPUE's are presented, one based on the NMFS vessel interview program catch data, and one based on HDAR C-3 catch report data from commercial fishermen.

Calculation & Adjustment: MHI trips were screened to only include trips from the areas of Maui, Lanai, Molokai, and Penguin Banks that had at least 90% of the catch by weight in bottomfish. Additionally, some MHI small boats were excluded based on minimum annual landings criteria to correct for temporal changes in the fleet composition. The NMFS vessel interview data prior to 1988 does not allow separate Mau and Hoomalu CPUE calculations; therefore, the combined area NWHI CPUE is presented as well. The NWHI HDAR CPUE used data screened to only include trips where at least 90% of the catch by weight was bottomfish and at least 1000 pounds of bottomfish were caught. All catch data reported by the same licensee on consecutive days were collapsed to a trip summary, since 1) most other reports are apparent

multi-day trip summaries, and 2) consecutive day reporting may be reflective of marketing rather than fishing activity. There was an apparent absence of Hoomalu Zone trips from the mid-1960s until the late-1970s. The 95% non-parametric confidence intervals for the HDAR CPUE's were calculated by bootstrapping.

Comments: There is a long-term decreasing trend in MHI CPUE, with current values approximately one-third that of initial. The 1995 MHI CPUE value is the lowest value on record and the first under 200 pounds per trip. MHI trips are generally one day in length, so CPUE values presented here reflect catch per day as well as catch per trip.

The NMFS vessel interview NWHI CPUE for 1994 has increased substantially over the 1993 value for the Mau Zone and decreased slightly for the Hoomalu Zone. The sharp decrease in the Mau Zone HDAR CPUE value returns CPUE to the 1991-1993 level following a 1994 peak. The Hoomalu Zone HDAR CPUE shows an increase in 1995 after a sharp decline in 1994. The HDAR CPUE is used for NWHI SPR calculations since it is a longer time series and may better estimate virgin fishery catch rates. There are no correction factors for possible changes in trip duration or fleet composition.

Interpretation: Decreases in MHI CPUE to about one-third of early CPUE values signify a yellow light condition for the fishery in this area. The increase in the late 1980s MHI CPUE was due primarily to a large increase in uku catches alone and may not indicate an increase in abundance of other species. And decreases in CPUE from the 1989-90 highs may be a return to normal rather than a decrease in normal abundance. The reasons for differing trends in CPUE values for the Hoomalu Zone with differing data sources are unclear.

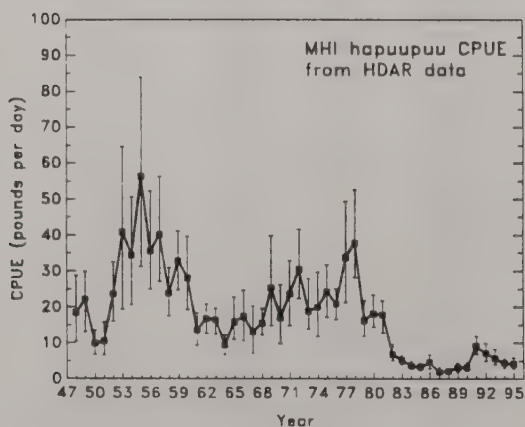
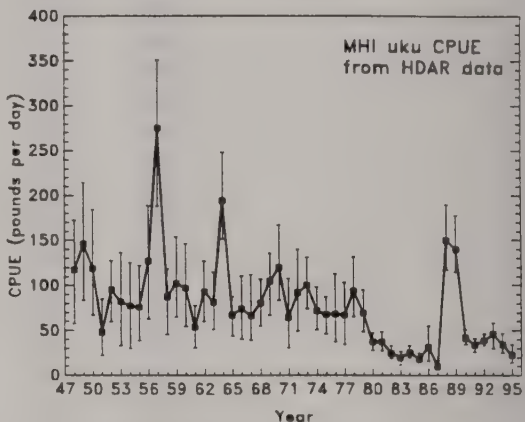
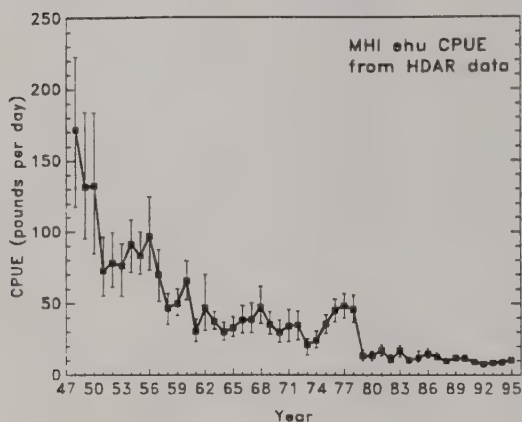
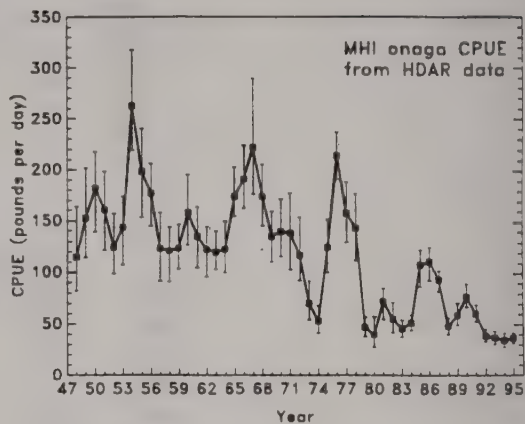
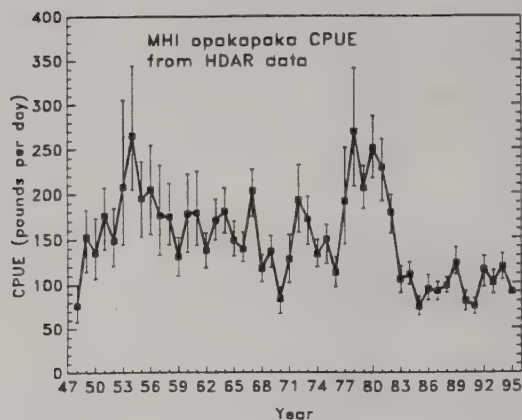
Figure 14-A data summaries:

Year	Pounds/Trip		
	MHI	Mau	Hoomalu
1948	614	5968	14635
1949	713	6799	4614
1950	677	4966	6072
1951	621	4980	8228
1952	577	7407	4766
1953	645	8937	7627
1954	887	6158	8613
1955	755	4659	9336
1956	784	2523	5202
1957	789	3958	1535
1958	533	NA	6254
1959	519	NA	5897
1960	630	6379	8139
1961	496	6999	7978
1962	491	4641	NA
1963	518	6410	NA
1964	619	8028	8390
1965	503	6656	NA
1966	536	4413	NA
1967	602	14749	NA
1968	478	6055	NA
1969	480	11484	NA
1970	433	7111	NA
1971	433	4784	NA
1972	514	2386	NA
1973	421	3224	NA
1974	329	3367	NA
1975	430	5439	NA
1976	485	4653	NA
1977	527	4387	4000
1978	635	4753	3550
1979	380	5361	4951
1980	421	6210	6687
1981	416	1336	8167
1982	307	NA	7953
1983	214	2242	3025
1984	220	4308	4085
1985	230	4239	5909
1986	274	2206	5301
1987	237	2889	8187
1988	329	2136	4702

1989	361	5412	5328
1990	245	4454	4793
1991	202	2413	5928
1992	228	2092	7388
1993	213	1992	8040
1994	217	3748	4626
1995	180	2460	5543

NMFS NWHI CPUE (lb/day)			
Year	Mau	Hoomalu	Combined
1984	NA	NA	682
1985	NA	NA	736
1986	NA	NA	800
1987	NA	NA	877
1988	322	866	786
1989	677	808	763
1990	573	675	611
1991	333	671	525
1992	239	639	491
1993	267	723	523
1994	385	625	472
1995	NA	NA	NA

Figure 14-B. Partial CPUE for MHI bottomfish



Source: The partial CPUE for the MHI is based on HDAR C-3 catch report data from commercial fishermen.

Calculation & Adjustment: The same subset of HDAR data as used in Fig. 14-A is used here, but the weight of each species is tabulated separately rather than in aggregate. The same denominator value used in Fig. 14-A is used here (# trips fished), i.e. summing these five partial CPUE's (and remaining BMUS CPUE's) will approximate the Fig. 14-A estimates. 95% non-parametric confidence intervals were calculated by bootstrapping.

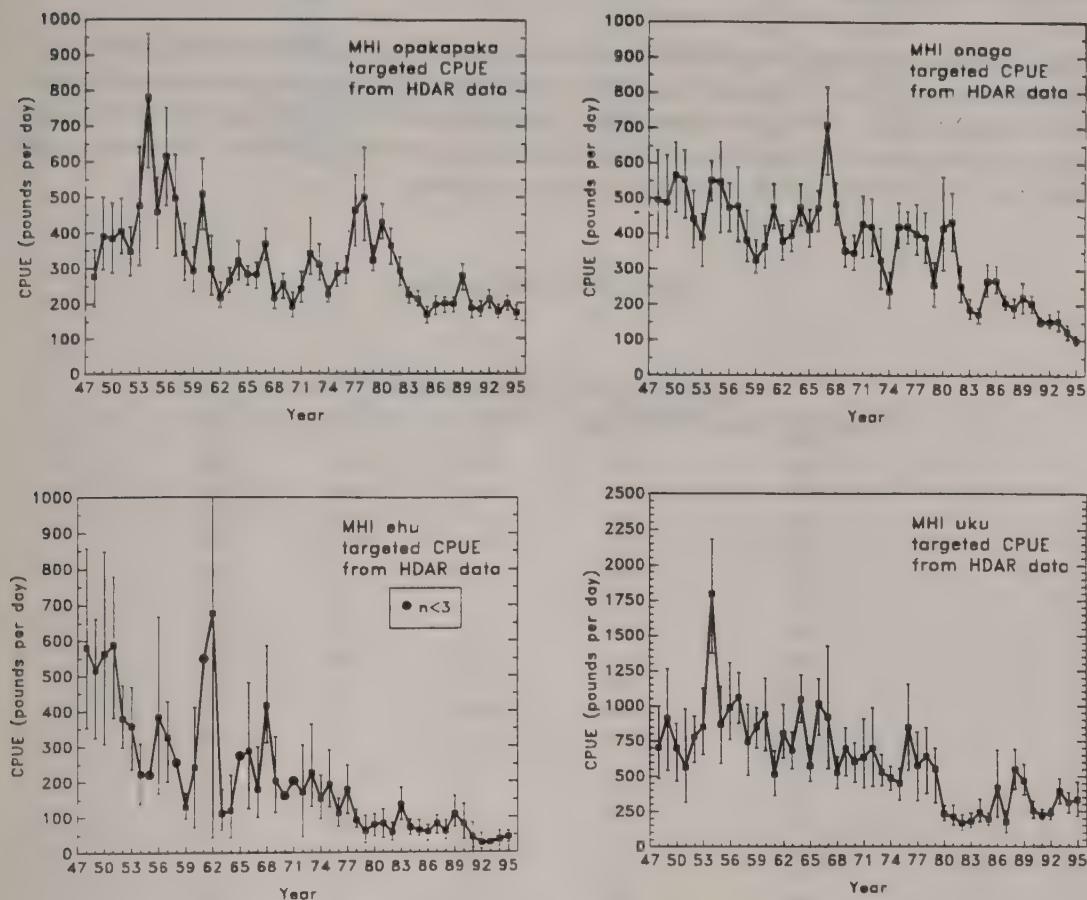
Comments: All CPUE time series remain highly variable. There are apparent declines in most species when comparing several years of recent values with values earlier in the time series. The decline is least apparent in opakapaka and most apparent in ehu. MHI trips are usually of one day duration.

Interpretation: Reduction of species-specific CPUE for species presented here to less than half of their early values would suggest a yellow light situation for these species, especially ehu and onaga. Caution must be used in this interpretation because factors such as targeting of effort to specific species is not taken into account (see next section for targeted effort).

Figure 14-B data summary

Year	MHI Partial CPUE (lb/trip)					
	OPA	ONA	EHU	UKU	HAP	ULU
1948	77	115	172	117	18	37
1949	153	153	132	146	22	61
1950	135	182	132	119	10	20
1951	176	161	73	48	11	15
1952	149	124	78	95	24	26
1953	208	144	76	82	41	19
1954	266	262	91	77	35	8
1955	195	198	83	76	56	8
1956	204	177	97	127	36	13
1957	176	124	70	275	40	20
1958	174	121	47	88	24	7
1959	130	124	50	103	33	14
1960	177	158	66	97	28	11
1961	178	136	31	54	13	13
1962	136	123	47	94	17	21
1963	169	120	38	82	16	20
1964	180	122	30	195	9	27
1965	148	174	33	67	16	11
1966	138	191	38	75	17	19
1967	203	222	39	66	13	13
1968	116	174	47	81	15	15
1969	135	135	35	104	25	10
1970	83	140	30	120	17	16
1971	127	138	34	65	24	12
1972	192	116	35	92	31	13
1973	171	70	21	101	19	14
1974	132	52	24	72	20	12
1975	149	124	36	68	24	15
1976	112	214	45	69	21	6
1977	191	158	49	67	34	8
1978	269	143	46	94	38	12
1979	207	47	13	70	16	15
1980	251	40	13	37	18	26
1981	229	72	18	37	18	8
1982	179	55	11	25	7	8
1983	104	46	17	20	5	8
1984	109	51	10	26	4	6
1985	74	107	12	18	3	3
1986	93	111	15	31	5	2
1987	91	93	13	10	2	3
1988	97	48	9	150	2	5
1989	122	59	12	140	3	7
1990	80	77	12	42	3	6
1991	75	60	9	34	9	4
1992	115	39	8	39	7	8
1993	100	37	9	46	6	4
1994	117	34	9	34	4	-
1995	90	37	10	23	4	-

Figure 14-C. Partial targeted CPUE for MHI bottomfish



Source: The partial targeted MHI CPUE is based on HDAR C-3 catch report data from commercial fishermen.

Calculation & Adjustment: The data used in Fig. 14-A were further screened to only include trips where at least 50% of the total catch by weight is the target species. This can only be done for species that are targeted successfully; incidental catch species will not contribute significantly enough to the overall catch. 95% non-parametric confidence intervals were calculated by bootstrapping.

Comments: As in Fig. 14-B, there are apparent declines when comparing several recent years with values earlier in the time series. The decline is least apparent in opakapaka. The level of

screening done here severely reduces the size of the sample, and this may contribute to some of the observed variability.

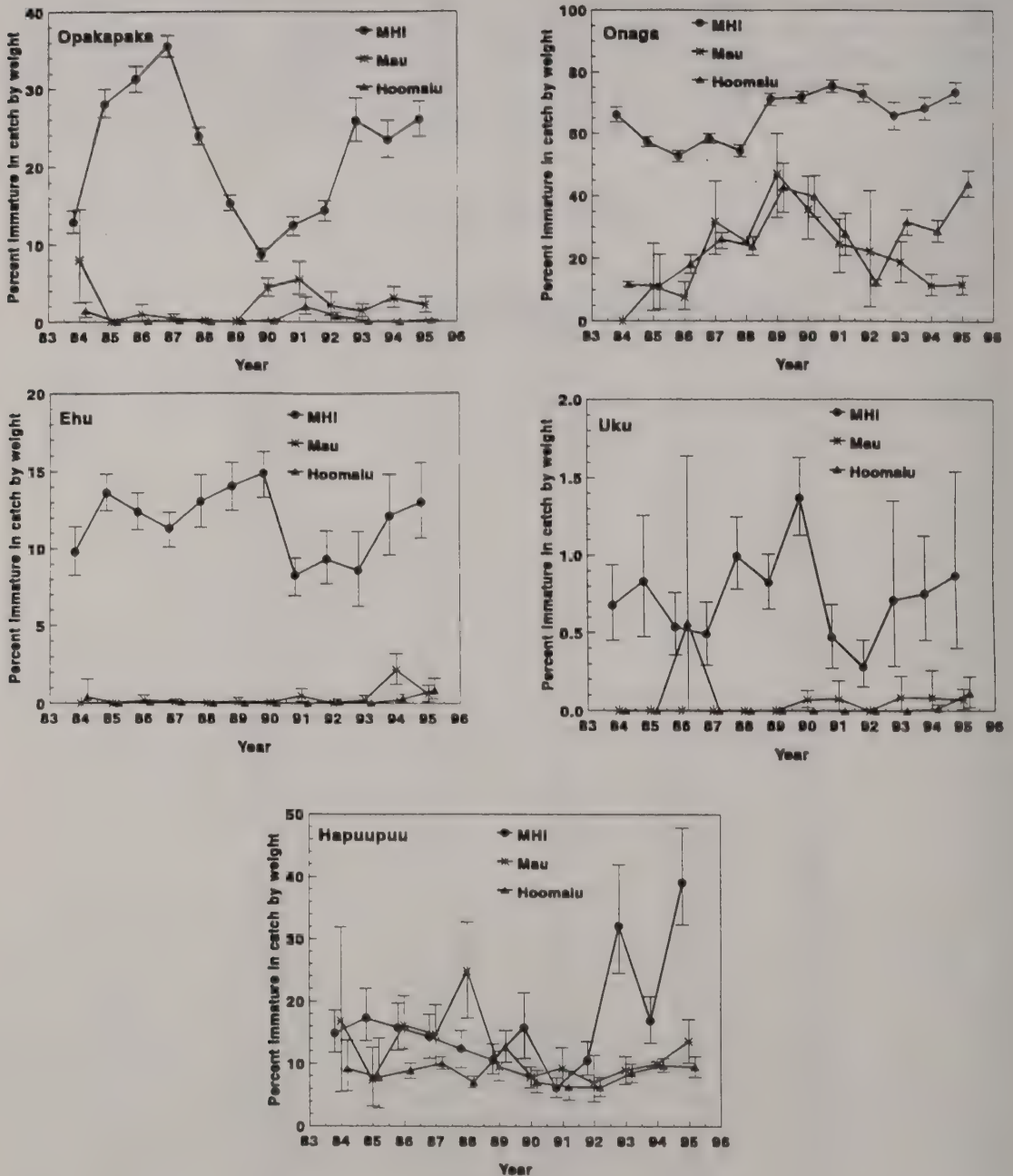
Interpretation: Comparison of CPUE values of the last 10 years (1986-95) with the first 10 years available (1948-57) indicate that all four species for which sufficient data is available have CPUE values less than 50% of original values. Opakapaka CPUE values are at 43% of original, onaga at 39%, ehu at 14% and uku at 37%. These values represent a yellow light condition for these four species, with the ehu stocks being the most stressed.

Figure 14-C data summary:

Year	MHI Targeted CPUE (lb/Trip)			
	Opakapaka	Onaga	Ehu	Uku
1948	277	496	581	705
1949	391	488	517	913
1950	385	566	564	701
1951	406	554	589	567
1952	348	442	380	779
1953	476	390	358	850
1954	779	552	224	1796
1955	458	547	222	869
1956	613	473	384	988
1957	496	479	327	1061
1958	344	382	257	745
1959	293	325	130	852
1960	507	364	242	939
1961	297	476	550	514
1962	216	379	677	806
1963	263	394	111	683
1964	320	475	120	1046
1965	281	411	275	574
1966	280	472	288	1014
1967	366	706	180	919
1968	215	484	415	525
1969	254	353	203	696
1970	191	345	161	600
1971	241	428	205	634
1972	339	420	171	699
1973	309	324	226	531
1974	225	236	152	488
1975	284	419	194	448
1976	293	421	112	846
1977	462	400	178	573
1978	501	389	92	640
1979	323	255	61	552
1980	430	415	79	235
1981	364	433	83	212
1982	293	252	58	164
1983	225	186	135	179
1984	212	173	72	241
1985	168	266	63	193

1986	194	267	58	418
1987	199	206	82	175
1988	198	192	60	549
1989	278	221	109	468
1990	187	205	82	260
1991	183	153	45	224
1992	212	154	27	238
1993	176	155	28	393
1994	200	125	37	311
1995	173	100	44	334

Figure 15. Percent immature in Hawaiian bottomfish catch



Source: Fish size data is derived from auction lot statistics obtained at the Honolulu UFA auction by HDAR,

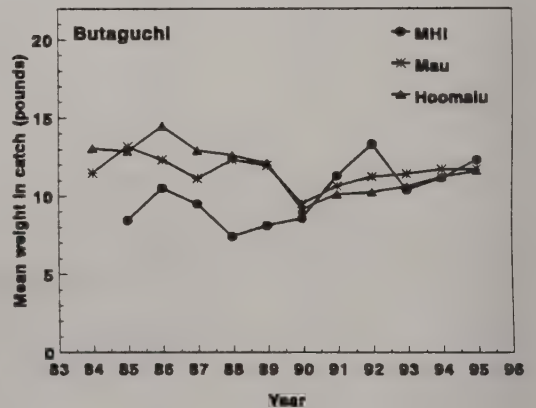
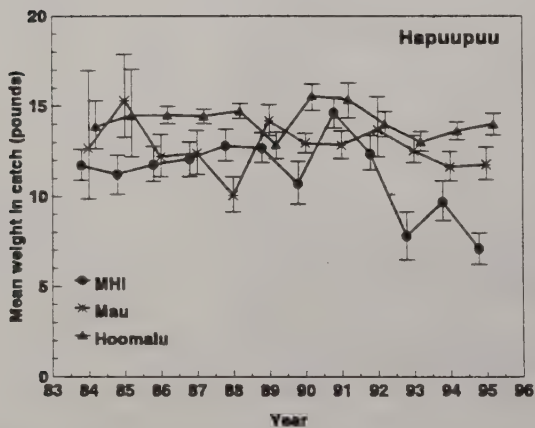
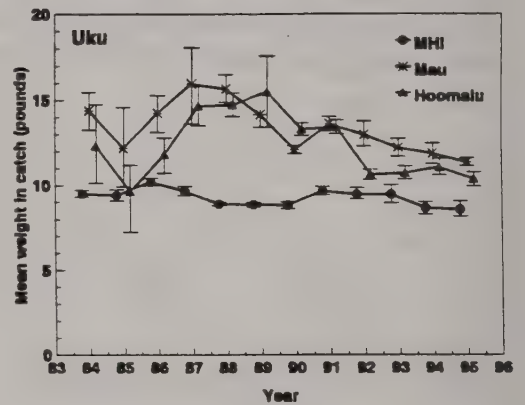
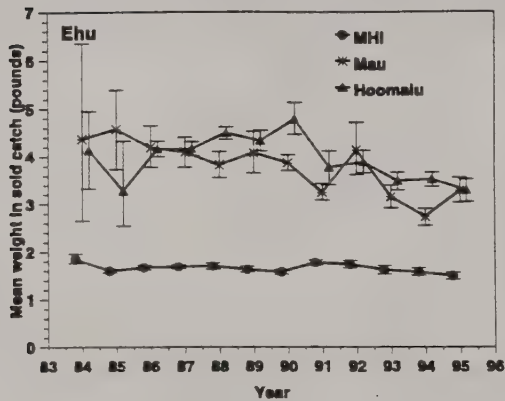
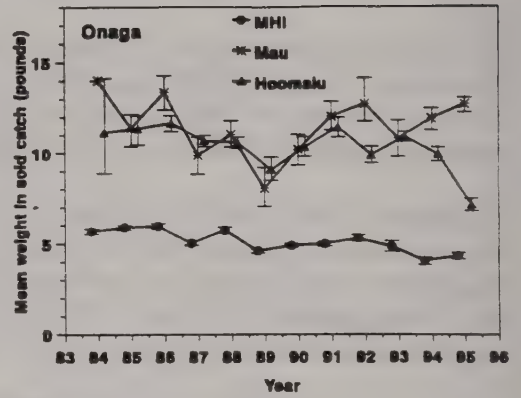
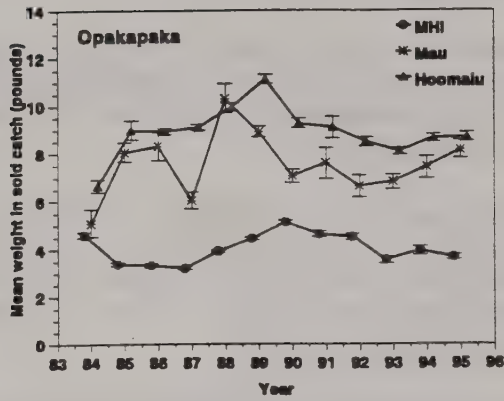
NMFS and WPRFMC personnel. Size at maturity from Everson (1984), Everson (1990 unpub. rep.), Everson et al. (1989), Kikkawa (1984), Sudekum et al. (1991).

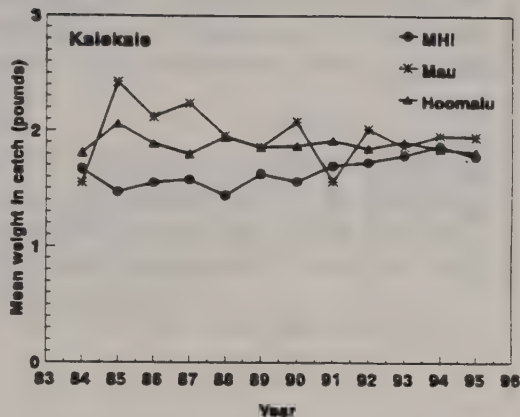
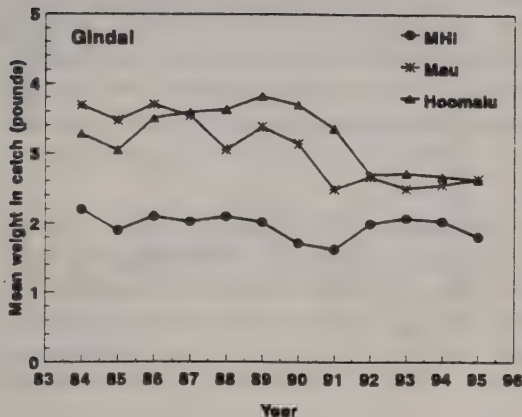
Calculation & Adjustment: The percent immature is calculated in terms of weight. The size distribution of sold fish is assumed to be representative of all fish caught. Maturity was assumed to be "knife-edge", and all fish in the same sales lot were assumed to be of equal size. 95% non-parametric confidence intervals were calculated by bootstrapping.

Comments: MHI catch is comprised of more immature fish than NWHI catch. In all areas onaga values are among the highest. Percent immature for uku are the lowest (i.e. healthiest) values in all zones. Among the other species, MHI opakapaka experienced periods of relatively high values (peaking in the years 1985-87). MHI Hapuupuu declined from a significant increase in 1993 back to its normal range in 1994 then rised sharply again in 1995.

Interpretation: MHI onaga catch has the highest percentage of immature fish, and is the only one consistently over 50%, signifying a yellow light condition. The NWHI stocks are all in the healthy range for percentage of immature fish in the catch, with the 1995 Hoomalu zone onaga value nearly at the yellow light level of 50%.

Figure 16. Mean weight of Hawaiian bottomfish





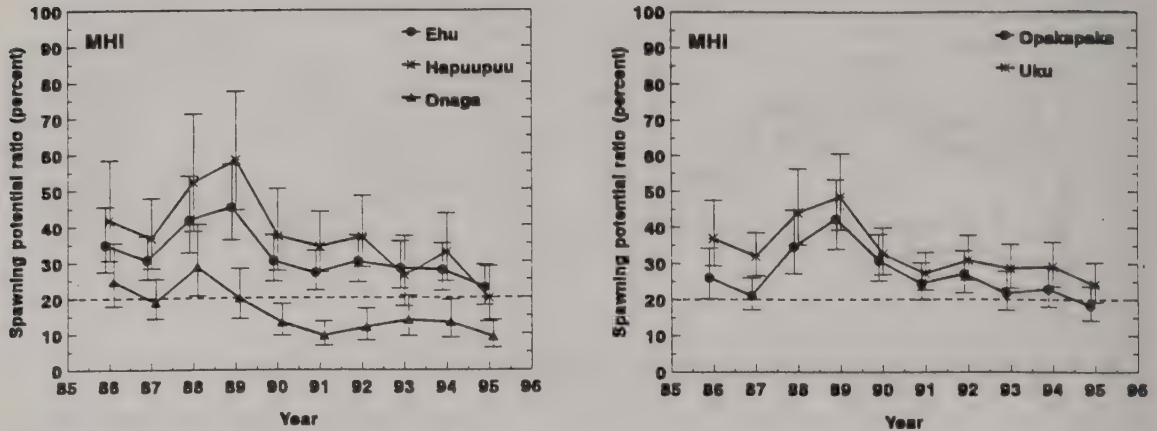
Source: Fish size data is derived from auction lot statistics obtained at the Honolulu UFA auction by HDAR, NMFS, and WPRFMC personnel.

Calculation & Adjustment: The size distribution of sold fish is assumed to be representative of all fish caught. All fish in the same sales lot were assumed to be of equal size.

Comments: Mean weights of fish in the NWHI catch are generally larger than those in the MHI catch. With the notable exception of the Hoomalu onaga mean weight, most 1995 values are similar to past values. The 1995 Hoomalu onaga value shows a sharp drop from the 1994 value, but is not part of an overall declining trend. MHI values have been remarkably stable for most species over the time series available, with continuously decreasing sizes found only in the MHI onaga and this decline is very gradual. MHI hapuupuu mean weight has fluctuated to a greater extent over the last three years with very low mean weights recorded for 1993 and 1995.

Interpretation: MHI mean weights are considerable lower than NWHI weights indicating considerable stress on these stocks. No noticeable trends can be seen in NWHI mean weights, indicating relative health of these stocks. Low mean weights recorded for hapuupuu in 1993 and 1995 appear to reflect actual drops in weight, and are not just due to an unusually small sample size of only small fish.

Figure 17. Spawning potential ratio (SPR) for MHI bottomfish



Year	SPR (%)				
	Ehu	Hapuupuu	Onaga	Opakapaka	Uku
1986	35	42	25	26	37
1987	31	37	19	21	32
1988	42	52	29	35	44
1989	45	58	20	42	48
1990	30	37	13	31	33
1991	27	34	9	24	27
1992	30	37	12	27	31
1993	28	26	14	22	29
1994	28	33	13	23	29
1995	23	20	9	18	24

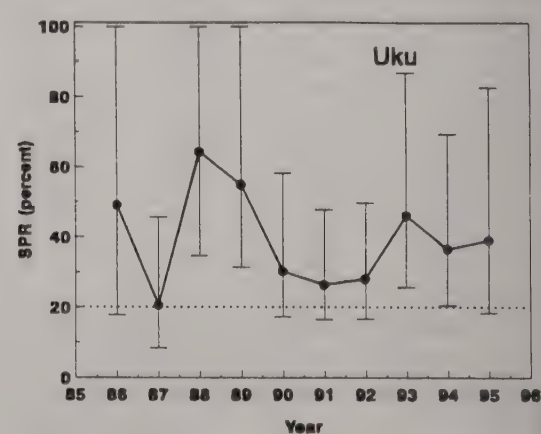
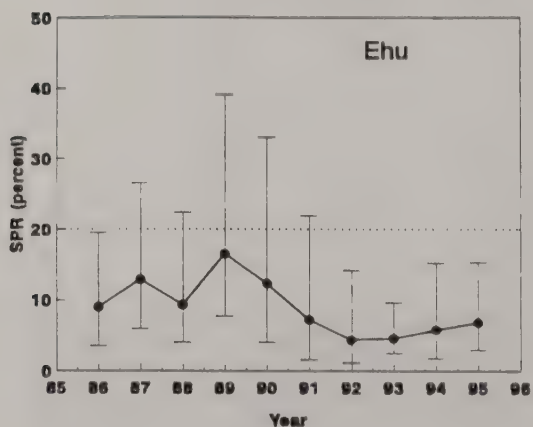
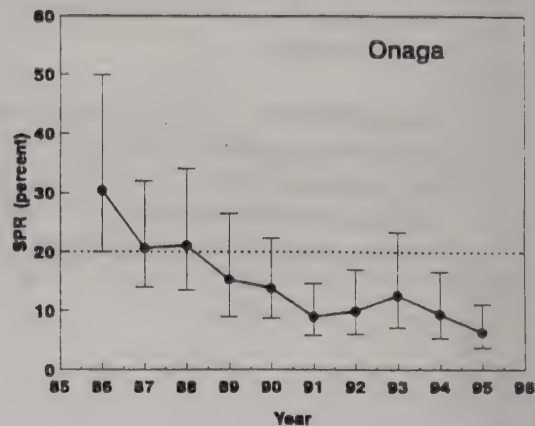
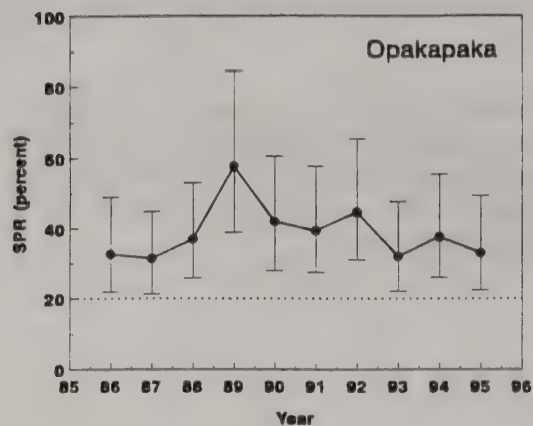
Source: SPR estimated from the Honolulu UFA auction size frequency data collected by HDAR, NMFS, and WPRFMC personnel; CPUE estimates from C-3 form data reported to HDAR by commercial fishermen. Additional information for opakapaka obtained from size frequency data of fish caught from the R/V Townsend Cromwell.

Calculation & Adjustment: Calculations use similar methodology as presented in Somerton and Kobayashi (1990) for dynamic SPR. Virgin CPUE estimate is 1948-1952 mean; current CPUE estimate is a single year estimate. CPUE is of aggregate bottomfish from the areas of Maui, Lanai, Molokai, and Penguin Banks (see Fig. 14-A for more details). Virgin catch size composition is estimated from the 1986-1988 NWHI catch data, and current catch size composition is estimated from single year MHI catch data. All SPR values changed slightly from previous year's reports due to improvements in the calculations. The 90.25% non-parametric confidence intervals were constructed based on "best" and "worst" case bounds of SPR components (95% bounds of CPUE and percent immature).

Comments: Current SPR estimates for only two of the five species are above the twenty percent critical level used as an indicator of recruitment overfishing. Onaga remains below 20% for the sixth year in a row. Hapuupuu and opakapaka SPR values dropped to 20% and 18% respectively, entering the critical zone for the first time. The sharp drop in hapuupuu SPR in 1995 is due to a combination of factors including a lower aggregate CPUE in 1995 and a marked rise in the percentage of immature individuals in the catch determined by a drop in mean weight.

Interpretation: The peak SPR values observed in 1988-1989 for all species were largely a response to increases in aggregate CPUE due to increased uku landings. Onaga, opakapaka, and hapuupuu SPR values indicate a red light situation for these species. Values for other MHI species have not been below the 20% threshold, but have occasionally been close and the lower confidence limits have dipped below this level on occasion.

Figure 17a. Spawning potential ratio (SPR) for MHI bottomfish using targeted CPUE



Year	SPR (%)			
	Opakapaka	Onaga	Ehu	Uku
1986	32.71	30.37	8.99	49.11
1987	31.43	20.60	12.91	20.57
1988	36.88	21.03	9.30	64.24
1989	57.60	15.31	16.54	54.87
1990	41.73	13.86	12.32	30.29
1991	39.18	8.99	7.23	26.37
1992	44.41	9.95	4.37	28.01
1993	31.93	12.65	4.56	46.13
1994	37.48	9.49	5.76	36.51
1995	31.35	6.34	6.80	39.09

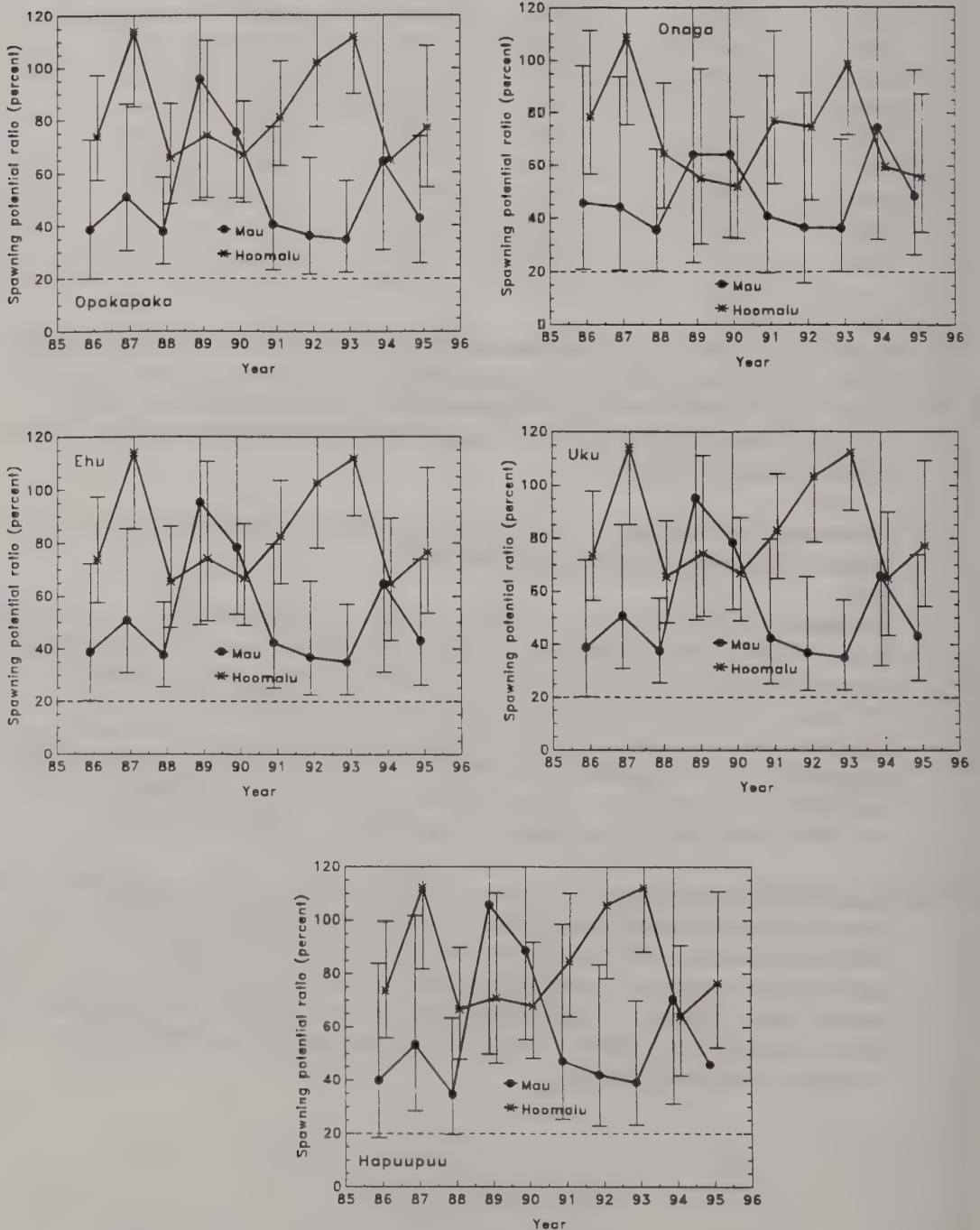
Source: SPR estimated from the Honolulu UFA auction size frequency data collected by HDAR, NMFS, and WPRFMC personnel; CPUE estimates from C-3 form data reported to HDAR by commercial fishermen and screened for trips targeting particular species. Additional information for opakapaka obtained from size frequency data of fish caught from the R/V Townsend Cromwell.

Calculation & Adjustment: Calculations are conducted as in the previous section with targeted CPUE substituting for aggregate CPUE.

Comments: This is the first year that SPR values have been calculated using targeted CPUE values. These values are available for only four of the BMUS species present in the MHI. As expected onaga and ehu values are below the 20% critical level and have been for many years. SPR values for each of these two species are lower using targeted CPUE than they are using aggregate CPUE. Opakapaka SPR values are higher using targeted CPUE compared to using aggregate CPUE. For opakapaka the 1995 SPR value obtained using aggregate CPUE indicates a critical situation (at SPR = 18%) whereas that using targeted CPUE indicates a non-critical level. Uku SPR values are non-critical using either CPUE method.

Interpretation: We feel that SPR values obtained here may better represent the condition of the stocks in regards to recruitment overfishing than those found in the previous section. Ehu and onaga stocks are clearly recruitment overfished, with ehu below the 20% level for the duration of our data and onaga on a continuing downward trend with values below 20% for the last 7 years. Contrary to the results obtained in the previous section, opakapaka SPR levels have remained above the 20% mark for all years sampled and does not indicate a critical recruitment overfished condition.

Figure 18. Spawning potential ratio (SPR) for NWHI bottomfish



Source: SPR estimated from Honolulu auction size frequency data collected by NMFS personnel, and CPUE estimates from C-3 form data reported to HDAR by commercial fishermen.

Calculation & Adjustment: Calculations use same methodology as presented in Somerton and Kobayashi (1990) for dynamic SPR. Virgin CPUE estimate is 1948-52 mean; current CPUE estimate is a single year estimate. CPUE is of aggregate bottomfish calculated separately for Mau and Hoomalu Zones. Virgin catch size composition is estimated from the 1986-88 NWHI catch data, and current catch size composition is estimated from single year catch data. All SPR values changed slightly from previous year's reports due to improvements in the calculations. 90.25% non-parametric confidence intervals were constructed based on "best" and "worst" case bounds of SPR components (95% bounds of CPUE and percent immature).

Comments: Current SPR estimates for all five species in both zones are above the 20% critical level used as an indicator of recruitment overfishing though lower confidence limits often are near or slightly below this level. Mau Zone SPR estimates tend to be lower than Hoomalu Zone SPR estimates for most species, and onaga SPR estimates tend to be slightly lower than those for most other species.

Interpretation: The correlation of SPR values among species is due the high dependence of SPR on the CPUE component, given that the maturity component is nearly negligible. All species utilize the same aggregate bottomfish CPUE component. The maturity component is small relative to MHI SPR calculations because 1) the NWHI catch is primarily mature fish, and 2) the current catch size composition is relatively unchanged from the best estimate of the virgin catch size composition. Presently, there are no means by which to calculate a targeted CPUE for this fishery. However, the newly adopted data form may allow improved calculations in the future, possibly at the resolution of species:bank:year.

Mau Zone SPR (%)					
Year	Ehu	Hapuupuu	Onaga	Opakapaka	Uku
1986	39	40	46	39	39
1987	51	53	44	51	51
1988	38	35	36	38	38
1989	95	106	64	96	95
1990	78	89	64	75	78
1991	42	47	41	40	42
1992	37	42	36	36	37
1993	35	39	36	35	35
1994	65	71	75	64	66
1995	43	46	49	43	43
Hoomalu Zone SPR (%)					
1986	74	74	78	74	74
1987	114	112	109	114	114
1988	66	67	65	66	66
1989	74	71	55	74	74
1990	67	68	52	67	67
1991	83	85	77	81	83
1992	103	106	75	102	103
1993	112	112	99	112	112
1994	65	64	60	65	65
1995	77	77	56	77	77

ARMORHEAD STOCK ASSESSMENT

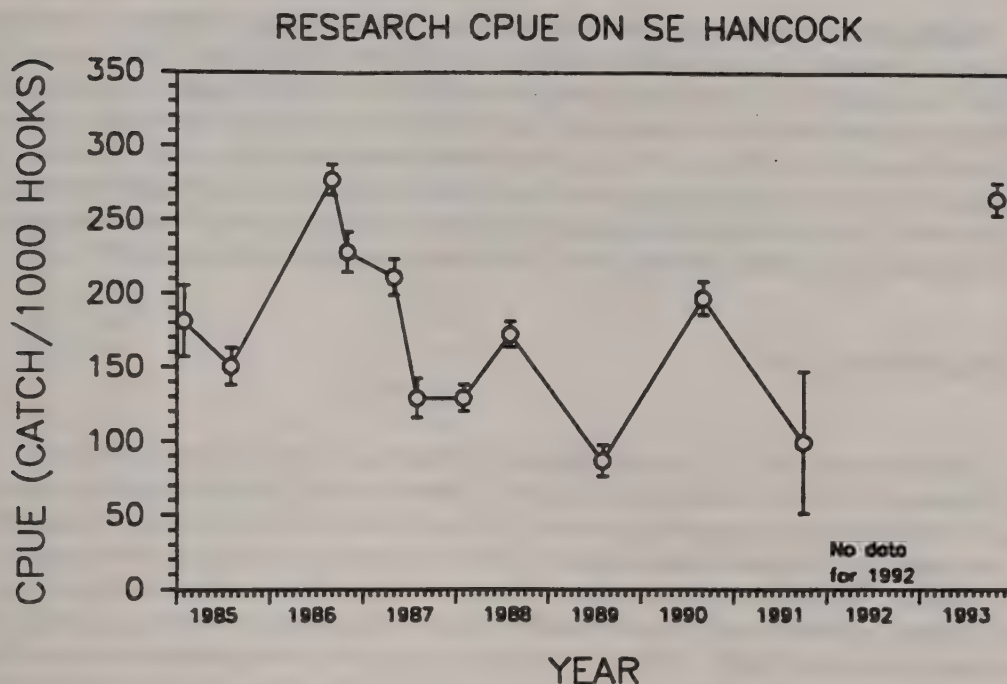


FIGURE H-18

DATA SOURCE:

Figure H-18 presents CPUE based on research longline catches at SE Hancock Seamount by NMFS, Honolulu personnel aboard NOAA ship R/V Townsend Cromwell. Vertical bars represent the 95% confidence intervals about the mean CPUE. The CPUE derived from the September 1991 stock assessment survey was computed using data from only the first 5 bottom longline sets as opposed to the standard 40 sets used on all other research surveys. The armorhead population at SE Hancock Seamount was not assessed in 1992 and post-1993 and therefore no current CPUE estimates are available. The latest stock assessment survey for armorhead at SE Hancock Seamount was conducted in October 1993. Future NMFS armorhead stock assessment cruises to SE Hancock Seamount are unlikely. Henceforth, annual armorhead SPR values for Colahan Seamount (located outside the U.S. EEZ) will be provided to serve as a relative indicator of armorhead stock levels at the Hancock Seamounts (see explanation in

Calculations & Adjustments subsection of ARMORHEAD SPAWNING POTENTIAL RATIO section).

CALCULATIONS & ADJUSTMENTS:

Fishing gear and sampling methods utilized during armorhead stock assessment surveys at SE Hancock Seamount are described in Somerton and Kikkawa (1992; Fishery Bulletin, U.S. 90:756-769). The seamount is divided into quadrants and effort is portioned equally among quadrants. Within each quadrant, effort is conducted over four depth strata (<265 meters (m), 265-300 m, 301-400 m, and 401-500 m). CPUE is calculated as a depth stratified average. Based on gear comparison studies of fishing droppers with and without hook timers conducted on the August 1990 survey, new coefficients accounting for the negative effects of hook timers were computed and applied to the catches obtained on all SE Hancock research surveys since 1985.

INTERPRETATION:

The fluctuations in CPUE shown in Figure H-18 are apparently the result of episodic recruitment followed by high natural mortality. These peaks in CPUE correspond to years (1986 and 1990) where an appreciable proportion (at least one-third) of the armorhead population consisted of fat individuals (fatness index ≥ 0.26) considered new recruits to the seamount population. Fatness index is defined as body depth divided by fork length. Subsequent to recruitment individuals cease somatic growth and over the course of 3-4 years, survivors decline in fatness index and weight. Without subsequent recruitment to the population in succeeding years, the armorhead population as a whole would decline both in numbers (natural mortality) and in biomass (declining fatness index). The high 1993 CPUE is unusual, however, since fat individuals (new recruits) account for <15% of the 1993 population while leaner individuals (<0.23 in fatness index) form the bulk of the population. These results apparently indicate that the 1993 population is primarily derived from recruitment which occurred either in late 1991 or during 1992. Previous work indicates that little if any annual recruitment to SE Hancock Seamount occurs after the summer months (Humphreys et al. 1993; Fishery Bulletin, U.S. 91:455-463). Since the 1991 stock assessment survey coincided with the end of the summer season, the increase in CPUE at SE Hancock for 1993 is most likely due to good recruitment during 1992. The sharp increase in the 1992 CPUE among seamounts outside the U.S. EEZ implies that a high recruitment occurred (across all seamounts) in 1992.

TABULATED VALUES:

MONTH/YEAR	ARMORHEAD CPUE
JAN 1985	181.28
JUN 1985	150.51
AUG 1986	276.80
OCT 1986	228.03
APR 1987	210.98
AUG 1987	128.73
JAN 1988	128.77
JUL 1988	172.14
JUL 1989	86.69
AUG 1990	197.08
SEP 1991	98.97
1992	(unknown)
OCT 1993	264.85
1994	(unknown)
1995	(unknown)

ARMORHEAD SPAWNING POTENTIAL RATIO

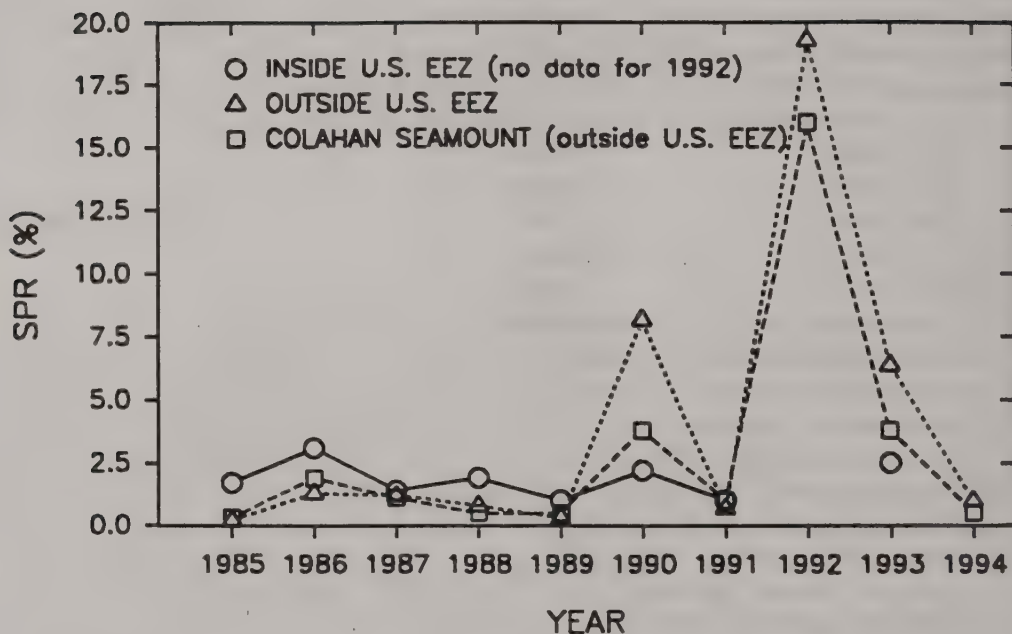


FIGURE H-19

DATA SOURCE:

SPR values for seamounts outside the U.S. EEZ are based on reported catch and effort data from the Japanese trawler fleet and values for seamounts within the U.S. EEZ (Hancock Seamounts) are based on research longline CPUE in addition to the trawl CPUE. However, with the cessation of research longline cruises to the Hancock Seamounts, SPR values for Colahan Seamount (comparable in size and located closest to the Hancocks among seamounts outside the U.S. EEZ) are being provided now and in the future as an indicator of stock levels at the Hancock

Seamounts. SPR values for Colahan Seamount are also based on reported catch and effort data at that seamount by the Japanese trawler fleet.

CALCULATIONS & ADJUSTMENTS:

SPR values outside the U.S. EEZ are computed as the current year CPUE divided by the average CPUE during the first three

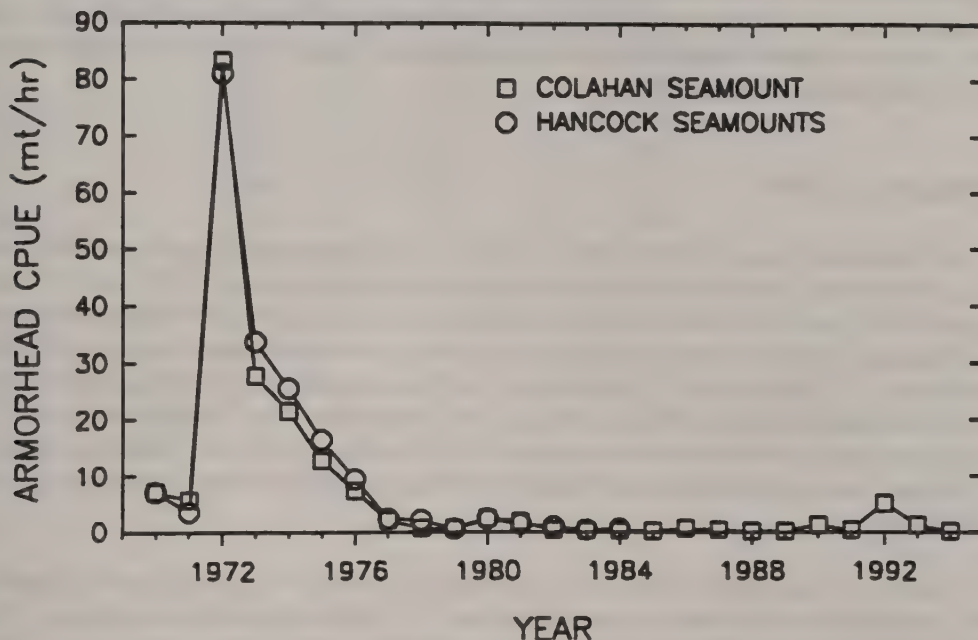


FIGURE H-20

years of the fishery (1970-1972). SPR values inside the U.S. EEZ are computed as the estimated biomass on SE Hancock Seamount divided by the 1970-1972 average biomass. Biomasses are estimated using procedures described in Somerton and Kikkawa (1992). The SPR values for Colahan Seamount are computed as the current year CPUE divided by the average CPUE during the first three years of the fishery (1970-1972) at Colahan Seamount (Figure H-19).

The decision to use SPR values for Colahan Seamount (instead of the overall outside U.S. EEZ values) as an indicator of armorhead stock conditions inside the U.S. EEZ (i.e., Hancock Seamounts) is based on the greater similarities between these seamounts. Aside from Colahan

Seamount, the seamounts fished for armorhead outside the U.S. EEZ are Milwaukee Seamounts and Koko Seamount. These latter seamounts have summit areas of 67 and 564 nm² and average summit depths of 190 and 170 fm, respectively, while Colahan and the Hancock Seamounts have much smaller summit areas (about 1.4 nm²) and shallower summit depths (141-150 fm). Fishing effort by the Japan trawl fleet has historically been different at these two types of seamounts. Koko and Milwaukee Seamounts have always received the majority (about two-thirds) of the annual total trawling effort and were typically fished intensively over a sustained period of time. However, the fishing effort at Colahan and the Hancock Seamounts was applied in pulses since catch levels could not be sustained for more than several days without a "cooling off" period. These similarities plus the historical close coincidence between Colahan and Hancock Seamounts in temporal profiles of armorhead CPUE from the Japan trawl fleet (Figure H-20) indicate that SPR values for Colahan Seamount should provide the best future indicator of armorhead stock levels at the Hancock Seamounts.

INTERPRETATION:

SPR within the region outside of the U.S. EEZ, which historically (Japan trawl fleet during the 1969-1981 period) contributed 91% of the total catch of armorhead, is 1.0%; based on the most current (1994) available catch and effort statistics from the Japan North Pacific trawl fishery. This indicates a continued sharp decline in stock levels since the dramatic increase of SPR levels outside the U.S. EEZ in 1992. This continued decline outside the U.S. EEZ is interpreted to be a result of sustained intensive effort on the high 1992 recruitment stock coupled with little recruitment during 1993-1994 to compensate for losses due to fishing and natural mortality. Based on previous trends, catch levels are expected to remain low in 1995 unless offset by an increase in recruitment.

Based on current estimates of a 2-2.5 year pelagic phase prior to seamount recruitment, the 1992 recruitment would have originated from the 1989-1990 winter spawning season. If this is correct, then the large 1992 recruitment originated from a parental stock which in 1989 had the lowest SPR values both inside and outside the U.S. EEZ (see table next page). This would appear to support the notion that dramatic increases in armorhead abundance across the seamounts are episodic and the product of environmental factors rather than simply a stock-recruitment relationship.

A Japan research trawl survey of the seamounts outside the U.S. EEZ was planned for August 1995 but has been rescheduled for February-March 1997. Results of this survey, particularly at Colahan Seamount, should provide a more current indication of relative stock levels at the Hancock Seamounts.

TABULATED VALUES:**ARMORHEAD SPR (%)**

YEAR	INSIDE US EEZ	COLAHAN	OUTSIDE US EEZ
1985	1.7	0.3	0.2
1986	3.1	1.9	1.3
1987	1.4	1.1	1.2
1988	1.9	0.5	0.8
1989	1.0	0.5	0.3
1990	2.2	3.8	8.2
1991	1.0	1.0	0.7
1992	NA	16.0	19.3
1993	2.5	3.8	6.4
1994	NA	0.5	1.0
1995	NA	NA	NA

Appendix 4

Northern Mariana Islands

Introduction

The Northern Mariana Islands (NMI) bottomfish fishery occurs primarily around the islands of Saipan, Tinian, Rota, Farallon de Mendilla, Anatahan and Aguigan. However, this discussion will be limited to the catches landed on Saipan which is by far the largest market. The fishery will be characterized by data collected through the Commercial Purchase Data Base which indirectly records actual landings by recording all local fish sales to commercial establishments. This data collection system is dependent upon first-level purchasers of local fresh fish to accurately record all fish purchases by species categories on specially designed invoices. Division of Fish and Wildlife (DFW) staff routinely collect and distribute invoice books to more than 60 participating local fish purchasers; which include practically all fish markets, stores, restaurants, hotels, government agencies and roadside vendors (fish-mobiles). Although this data collection system has been in operation since the mid-1970s, only data collected since 1983 are considered accurate enough to be comparable for most aspects of the fisheries.

The NMI's bottomfish fishery still consists primarily of small-scale local boats engaged in commercial and subsistence fishing but recently a trend of larger vessels (35'-50') are entering this fishery. Deepwater (>500 ft) fishing, targeting onaga and other prized snappers, are largely commercial, whereas, those targeting shallow water (100-500 ft) species, such as the emperors, can also be subsistence. Handlines, home fabricated hand reels and electric reels are the common gear used for small-scale fishing operations, and electric reels and hydraulics are the common gear used for the larger operation in this bottomfish fishery. Historically, some trips lasted more than one day, currently however, effort is defined and calculated on a daily trip basis. Fishing trips are generally restricted to daylight hours, with all vessels returning before or soon after sunset. The bottomfish fleet, in terms of participation, consists primarily of vessels less than 24 feet in length and are usually limited to a 20-mile radius from Saipan. The larger vessels that are able to fish extended trips, sometimes traveling as far as Pagan, have landed most of the bottomfish that were reported through the purchase receipt form. In 1995, two major bottomfish operators continued operation, in which a large volume of onaga (*Etelis coruscans*) and giant grouper (*Epinephelus octofasciatus*) were being harvested. One of the operators subsequently suspended its entire operation toward the end of the year due to financial predicament incurred with its main office, but another company (owned by a former CNMI Governor) started its own operation just about the same time with two 50' Japanese built vessels.

Bottomfishing requires more skill than pelagic trolling and requires knowledge of the location of specific submerged bottom features and hooking techniques. Presently, bottomfish fishing can still be described as "hit or miss" for most of the smaller size (14-25 ft.) vessels. Without fathometers and even nautical charts, the majority of fisherman utilizing small size vessels fish randomly, many times relying on land features for guidance to a fishing area. This type of fishing is very inefficient and usually results in a low CPUE when compared with pelagic trolling. With the larger size (25 ft. and above) vessels, bottomfishing is different in that most highliner operators utilize Global Positioning System (GPS), fathometers and electric reels.

Summary

Bottomfishing in the NMI has steadily improved from its previous decline five years ago, and it continues to show recovery by its sign of increased landings. This improvement in "growth" in the fishery is evidenced by the 42% increased over 1994 landing and 96% increased over 1993. Domestic US, joint-venture, and foreign vessels are still continuing their inquiry about full-time bottomfishing throughout much of the NMI. The impact to the commercial market is still unclear despite a fish market assessment study that was conducted in 1994. Frequent samples were conducted on the full time bottomfish operators and a draft report of this study has just been completed and the final report will soon be available.

The total number of bottomfishing operations and trips to islands north of Saipan, where bottomfish are more abundant, has been increasing in recent years.

Revenues and prices will continue to increase with renewed fishing interest, larger financial investment and increased utilization of modern electronics and equipment. Deepwater snappers still command the best prices. Fishermen utilizing larger vessels will have greater access to these fish; the market for them will continue to improve as the supplies of these fish remain consistent and quality are well maintained. With a proper training program in bottomfishing that addresses proper fish handling, fathometers and nautical charts, use of modern electronic equipment, such as GPS, fish finders, electric reels, anchoring techniques and marketing, this industry should continue to grow.

With the planned expansion of biological data collection from the bottomfish fishery, an assessment should be completed for the bottomfish stocks surrounding Saipan. After identifying the extent of resource utilization, additional data collecting could be used to help determine comprehensive management strategies. Continued sampling of vessels fishing bottomfish plus actual fishing by DFW in the northern islands could provide a better CPUE of the fishery for these areas.

Recommendations

- 1) Establish an immediate three to five years study program that will specifically monitor, assess and analyze bottomfish being landed that are harvested, especially from the Northern Islands.
- 2) Establish baseline (virgin stock) parameters (CPUE, percent immature) for the Guam/Northern Marianas deep-water bottomfish complex (e.g., survey on grouper, snapper) utilizing data collected during Resource Assessment Investigation of the Marianas Archipelago (RAIOMA) cruises (1981-1984), the current fishing in the Northern Islands and sampling aboard DFW research vessel to help calculate SPR, with assistance from NMFS.
- 3) Establish baseline (virgin stock) parameters (CPUE, percent immature) for the Guam/Northern Marianas shallow-water bottomfish complex (e.g., red-gilled emperor) by sampling program aboard DFW research vessel to help calculate SPR, with assistance from NMFS.

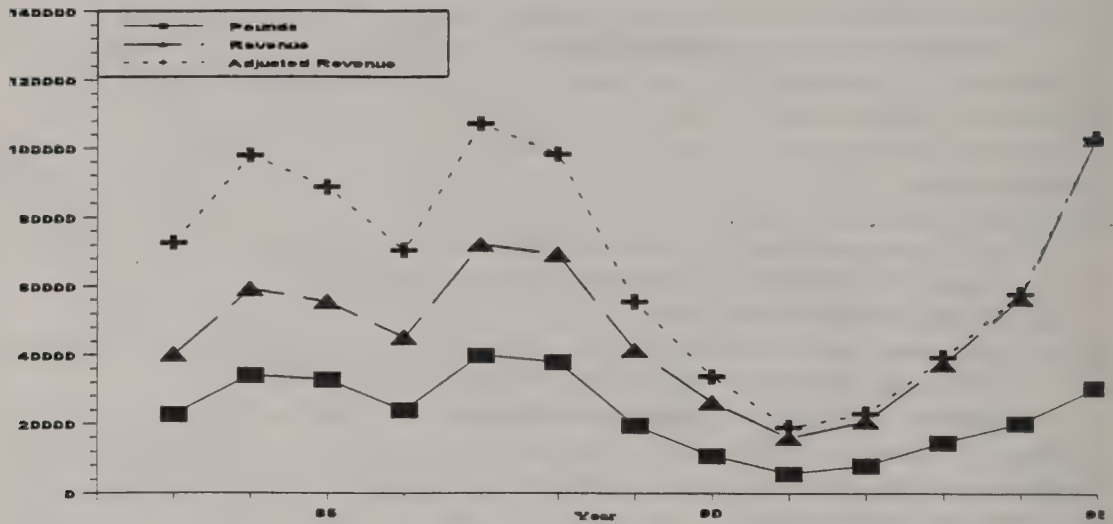
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Figure 1. NMI commercial bottomfish landings and revenue.



Year	Pounds	Unadjusted Revenue	Inflation-Adjusted Revenue
1983	22,683	40,003	72,405
1984	33,924	59,005	97,948
1985	32,780	55,396	88,634
1986	23,929	45,079	70,323
1987	39,772	71,868	107,083
1988	37,850	69,052	98,054
1989	19,550	41,379	55,448
1990	10,903	26,323	33,693
1991	5,693	16,118	19,019
1992	8,148	21,032	23,135
1993	14,769	37,310	39,176
1994	20,363	56,405	57,533
1995	30,522	103,030	103,030
Average	20,841	49,169	59,575
Standard Deviation	11,281	23,641	31,179

Calculation: Landings in pounds are from a simple data base summation of reported purchases of all bottomfish species combined. Revenue in dollars is from the same type of data base summation of the value field. The inflation adjustment is made using the Consumer Price Index (CPI) and establishing the 1995 CPI figure as the basis by which calculations of previous years' prices are made.

Interpretation: Landings, revenues and adjusted revenues for 1995 have increased over 1994. The increase is attributed to the increase in Bottomfishing operation (Fig. 3), especially with the full time - full year operation of one of the fishing venture that operated in 1995.

Table 1. NMI 1995 commercial landings of bottomfish species

Species	Landings (lb)	Revenue (\$)	Ave. Price (\$/lb)
Bottomfish*	8,977	24,944	2.78
Jacks	487	1,302	2.67
Gindai	979	3,086	3.15
Grouper	2,407	6,389	2.65
Onaga	13,120	55,409	4.22
Opakapaka	714	2,105	2.95
Lehi	417	1,435	3.44
Emperor	3,421	8,362	2.44
Subtotal	30,522	103,032	3.38

* denotes miscellaneous or non-identified species.

Calculation: Annual summaries for each species from invoice data sheets.

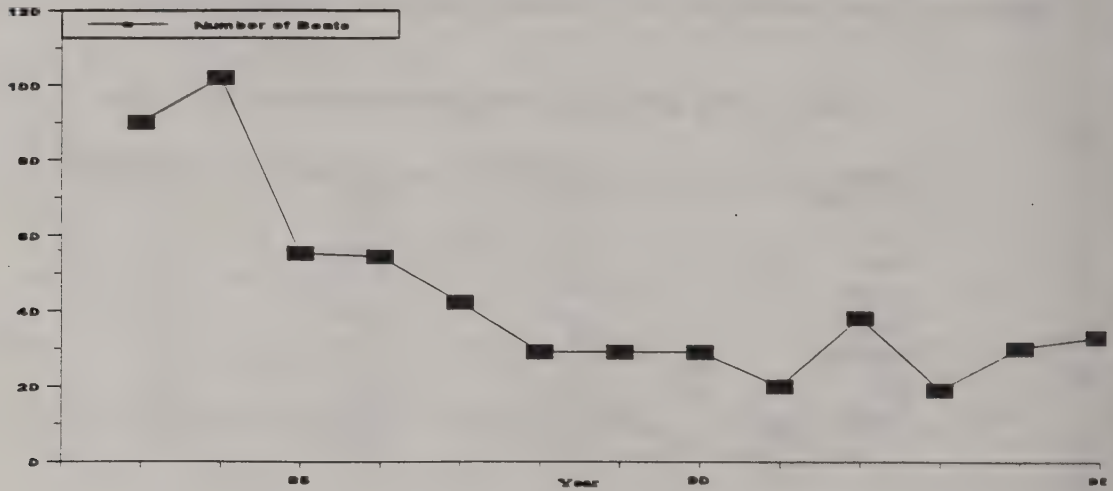
(Note: During 1995, the number of vendors increased along with the collection effort. There are about 33 participating local bottomfish fishermen (boats) compared to the approximate 32 that were recorded during 1994.)

Interpretation: Unfortunately, 30% of all 1995 bottomfish landings were not identified by species groups and any interpretations based on the above data would be questionable. Follow-up inquiry with vendors of this concern revealed that emperor species were predominant among these recorded bottomfishes.

The deepwater bottomfish, onaga, commanded the higher prices per pound, while prices for shallower-water bottomfish (groupers and emperors) ranged from \$1.52 to \$ 1.95 per pound less.

The high average price per pound of \$3.38 is primarily due to highliners selling their catch of bottomfish at higher wholesale price to more vendors.

Figure 2. Number of Fishermen (boats) making bottomfish landings



Year	Boats
1983	90
1984	102
1985	55
1986	54
1987	42
1988	29
1989	29
1990	29
1991	20
1992	38
1993	20
1994	32
1995	33
Average	44
Standard Deviation	26

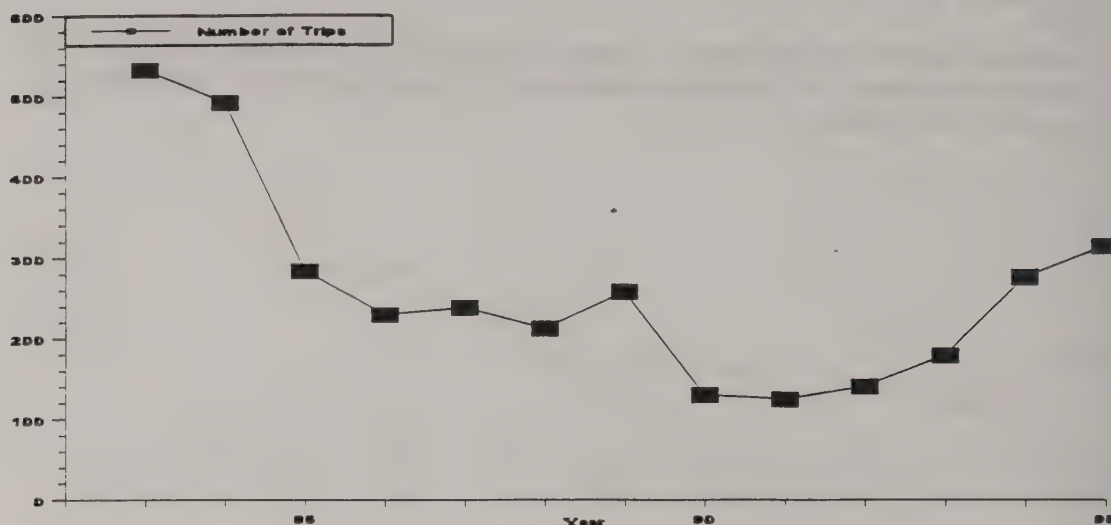
Calculation: The fisherman or boats selling the catch is identified on the "trip ticket" invoices used by purchasers. The plot shows the number of unique fishermen making any landings of bottomfish within a given year.

Interpretation: As with the number of trips (Fig. 3), the number of boats or fishermen making commercial landings of any bottomfish species declined from 1984 to 1988, stabilized between

1988-90, slight increase during 1992, decreased again in 1993, then increased during 1994 and holding up in 1995.

Although bottomfishing is showing an increase in the number of boats selling the catch in 1994, the number of larger (50' plus) vessels (responsible for more than 65% of the catches) fishing regularly also increased.

Figure 3. Number of NMI bottomfish trips

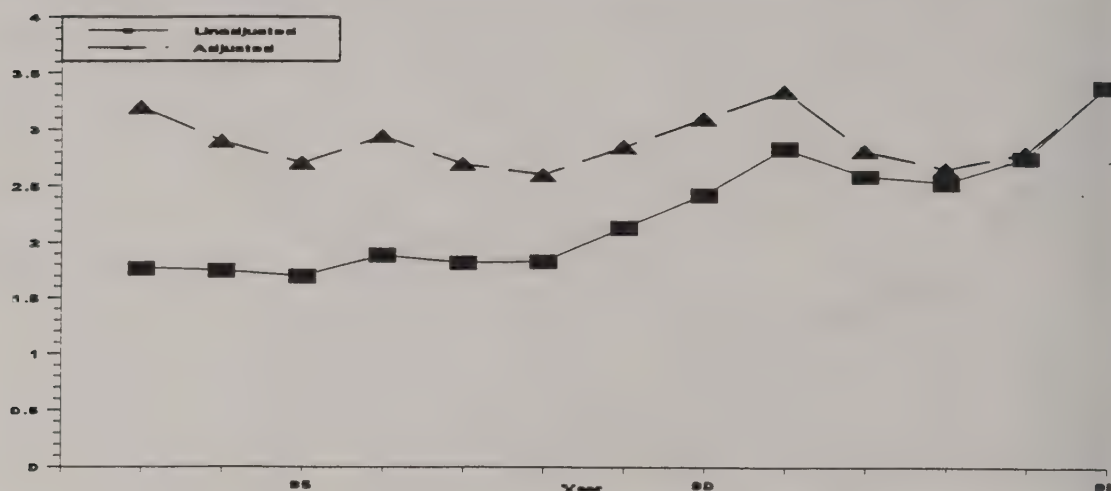


Year	Trips
1983	533
1984	492
1985	283
1986	229
1987	237
1988	211
1989	257
1990	129
1991	124
1992	140
1993	178
1994	275
1995	313
Average	262
Standard Deviation	127

Calculation: The number of trips which resulted in landing any bottomfish are tallied by adding each recorded fisherman's trip on a given day. The assumptions are that each fisherman lands only once in a given day, and that he sells all of his catch on that day. Most trips last a single day, but it is also known that the occurrence of longer fishing trips is increasing.

Interpretation: The increase that occurred in number of bottomfishing trips being taken by the NMI fleet is happening because there are now more full time operations conducting regularly scheduled long trips to the northern islands, where bottomfish are more abundant.

Figure 4. NMI average price of bottomfish



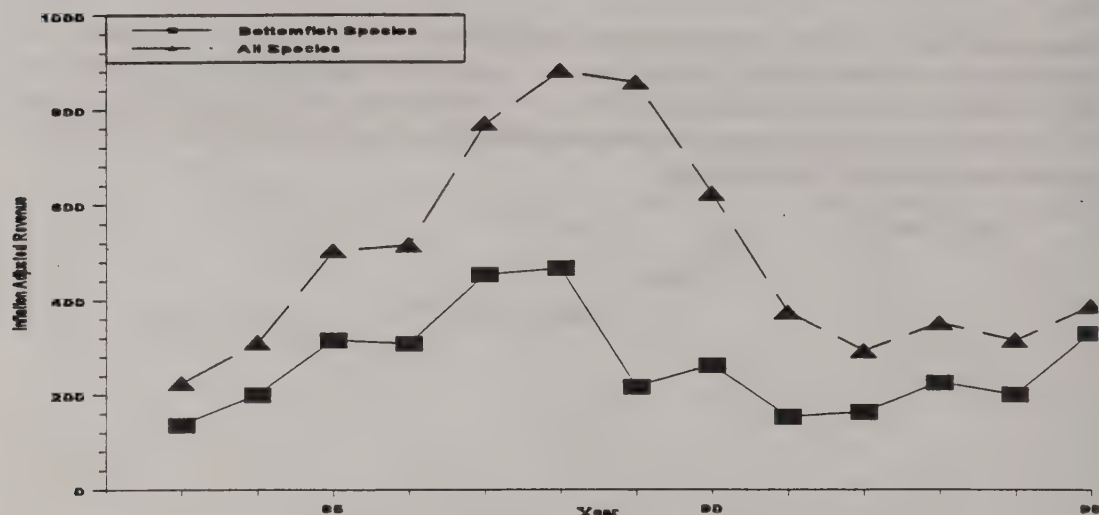
Year	Unadjusted \$/lb	Adjusted \$/lb
1983	1.76	3.19
1984	1.74	2.89
1985	1.69	2.70
1986	1.88	2.94
1987	1.81	2.69
1988	1.82	2.59
1989	2.12	2.84
1990	2.41	3.09
1991	2.83	3.34
1992	2.58	2.84
1993	2.53	2.65
1994	2.77	2.83
1995	3.38	3.38
Average	2.26	2.92
Standard Deviation	0.54	0.26

Calculation: The average price of the bottomfish complex is calculated by dividing the total revenue by the total landings. The inflation adjustment is made using the Consumer Price Index (CPI) and establishing the 1995 CPI figure as the basis by which calculations of previous years' prices are made. The CPIs for 1983-87 were not available from the appropriate NMI agency and

were, therefore, estimated by using Guam's annual inflation rate to proportionately adjust the 1988 NMI CPI.

Interpretation: The average price increased steadily from 1988 to 1991, where it reached what was once a record high of \$2.83. In 1995 however, the price increased to a new record high of \$3.36. This is a 59 cents increase over 1994's \$2.77. This increase was due to the large volume of bottomfish being landed and sold to more establishment as was the case in 19943. Re-sold catches are not included in this report.

Figure 5. NMI average inflation adjusted revenue per trip landing bottomfish



Year	Bottomfish Species		All Species	
	Unadjusted	Adjusted	Unadjusted	Adjusted
1983	75	136	124	224
1984	120	199	186	309
1985	196	314	314	502
1986	197	307	330	515
1987	303	451	517	770
1988	327	464	621	882
1989	161	216	639	856
1990	204	261	485	621
1991	130	153	316	373
1992	150	165	268	295
1993	210	221	329	345
1994	205	209	313	319
1995	329	329	386	386
Average	201	263	371	492
Standard Deviation	79	105	155	224

Calculation: Only trips which landed bottomfish are included in these calculations. "Bottomfish \$/Trip" is the total revenue of the bottomfish sold from a trip, and "All Species \$/Trip" is the total trip revenue of all species combined (e.g. any pelagic and reef fish which were sold).

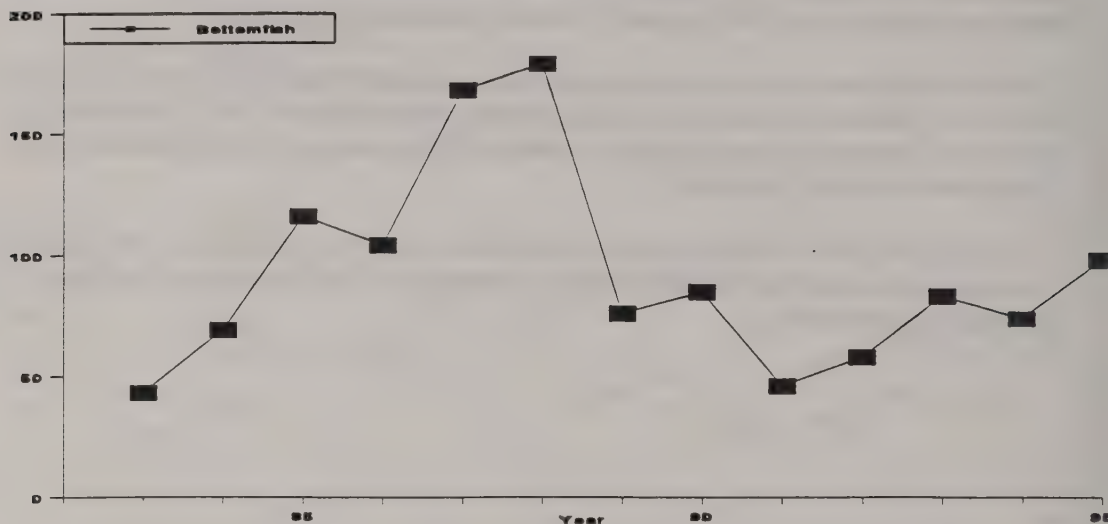
The inflation adjustment is made using the Consumer Price Index (CPI) and establishing the 1995 CPI figure as the basis by which calculations of previous years' prices are made. The CPIs for 1983-87 were not available from the appropriate NMI agency and were, therefore, estimated by using Guam's annual inflation rate to proportionately adjust the 1988 NMI CPI.

Interpretation: In general, inflation adjusted bottomfish revenue in 1995 increased significantly after experimenting a slight decrease in 1994. The all species inflation adjusted revenue, which had been declining since 1988, appears to have not stabilized at this point.

The actual difference in price for inflation adjusted bottomfish revenue increased when compared with 1994. Inflation adjusted for all species revenue also increased in 1995. Demand for bottomfish entering the market remained constant with previous years, despite the increase of high priced onaga and opakapaka.

The bottomfish fishery has always been a small proportion of the total fisheries, but it appears that bottomfish are comprising a relatively higher percentage of the trip revenue on trips where bottomfish were caught.

Figure 6. NMI bottomfish catch in average pounds per trip



Year	Pounds per Trip
1983	43
1984	69
1985	116
1986	104
1987	168
1988	179
1989	76
1990	85
1991	46
1992	58
1993	85
1994	74
1995	98
Average	97
Standard Deviation	41

Calculation: The average catch per trip is calculated by dividing the total weight of all bottomfish landings by the number of trips which landed bottomfish, regardless of the amount of bottomfish landed on any given trip. Although the average catch per trip is not a very good measure of CPUE, because it is subject to significant biases (e.g. changes in trip length and relative amounts of bottomfishing compared to trolling), it is the only measure readily possible from the commercial landings system. It may be possible to improve this measure of CPUE by using only those trips which landed bottomfish exclusively, but that has not yet been done. It is

believed that the sample size resulting from this exercise would be extremely small and subject to other biases. It should, however, be investigated in the future.

Interpretation: Even though bottomfish effort and landings are increasing slightly, the revenue obtained from bottomfish sales is relatively stable. This may be a function of the bottomfish fisherman trolling to and from the bottomfishing site, thus having a mixed catch after spending the day "bottomfishing".

Appendix 5. NMFS 1995 Administrative Activities

Northwestern Hawaiian Islands Bottomfish Fisheries

The northwestern Hawaiian Islands (NWHI) bottomfish fisheries, which come under a Federal permits program administered by the NMFS Southwest Region, consist of two permit areas: Hoomalu (limited access) and Mau (open access) Zones. In 1995, the Southwest Region issued a total of 29 NWHI bottomfish fishing permits, of which 9 were for the Hoomalu Zone and 20 for the Mau Zone. In addition, 4 persons were determined to be eligible for Hoomalu Zone permits but had not been issued permits by the end of the year.

The number of persons holding or eligible for Hoomalu Zone permits remained the same as the previous year. In the Mau zone, there was a net increase of three permit holders over 1994, which was attributed to six new permit holders and the exit of three former permit holders. Ten of the Mau vessels make bottomfish landing during the year.

Mau Zone (open access) vessels:

1. Aikane 49
2. Amber Rose
3. Boomerang
4. Crystal
5. Dasher II
6. Double D (new)
7. Honua-Oe
8. Imua
9. Iwalani
10. Jamie Elizabeth
11. J-Natsuko-O
12. Jenine
13. Kai Pali
14. Kasatka
15. Kealailani
16. Leo Marie (new)
17. Lisa I
18. Mana Loa (new)
19. Manu Aloha O'Ke Kai (new)
20. Pakahi (new)
21. Sea Eagle
22. Shanatu (new)
23. Wahine Kapaloa I

Hoomalu Zone (limited access) vessels:

1. E.T.
2. Fortuna
3. Four C's
4. Justin G
5. Kaimi Kai
6. Laysan
7. Pursuit
8. Tident
9. Windwalker
10. replacement vessel for Tiare
11. replacement vessel for Anna Riley

Appendix 6. NMFS 1995 Enforcement Activities

The following report is a combined effort of the U.S. Coast Guard 14th District and the NMFS Southwest Region Office of Enforcement. The report covers the period 1 January 1995 through 31 December 1995.

There were no significant MFCMA law enforcement cases relating to bottomfish/seamount groundfish fisheries that were prosecuted by the Coast Guard in 1995.

The Coast Guard continues to conduct surveillance of the Hancock Seamount area. The Coast Guard utilizes C-130 aircraft and cutters to patrol the Northwest Hawaiian Islands/Hancock Seamount.

Appendix 7. Protected Species and Habitat

Protected Species

Six bottomfish vessel operators completed the one-time Protected Species Workshop required to validate permits for the Hoomalu and Mau Zones in 1995.

No protected species interactions were observed in 1995.

Habitat Conditions and Recent Activities

Under the bottomfish FMP, regulations were implemented to prohibit the use of bottom trawls, bottom-set nets, explosives and poisons for harvesting bottomfish. This has served to greatly reduce the potential for bottomfish habitat degradation. To our knowledge, there have been no violations of these regulations in 1995.

As reported in earlier annual reports, there are several activities occurring, or reportedly occurring, in the EEZ that may potentially alter bottomfish habitat. These include:

1. Anchor damage by vessels attempting to maintain position over productive bottomfish habitat.
2. Habitat damage from heavy weights and line entanglements during normal hook-and-line bottomfish operations.

The potential threat to bottomfish habitat is reviewed throughout the Council's Ecosystem and Habitat Standing Committee. The Council has adopted a Habitat Policy which will assure that each FMP includes all available information on habitat significant to the species being managed.

Appendix 8. 1995 Bottomfish Plan Team Members

American Samoa:

Mr. Fini Aitaoto

American Samoa Dept. of Marine & Wildlife Resources, P.O. Box 3730, Pago Pago,
AS 96799, Telephone (684) 633-4456

Guam:

Mr. Andrew Torres

Guam Division of Aquatic & Wildlife Resources, P.O. Box 2950, Agana, GU 96910,
Telephone (671) 734-3986

Hawaii:

Mr. David C. Hamm

Mr. Robert B. Moffitt

Dr. Samuel G. Pooley

National Marine Fisheries Service Honolulu Laboratory, 2570 Dole St., Honolulu, HI
96822, Telephone (808) 943-1221

Mr. Skippy Hau

Hawaii Division of Aquatic Resources, 130 Mahalani St., Wailuku, HI 96793,
Telephone (808) 243-5327

Mr. Donald Heacock

Hawaii Division of Aquatic Resources, 3060 Eiwa St., #306, Lihue, HI 96766,
Telephone (808) 274-3344

Mr. Brooks H. Takenaka

United Fishing Agency, 117 Ahui St., Honolulu, HI 96813, Telephone (808) 536-2148

Northern Mariana Islands:

Mr. Richard B. Seman

Northern Mariana Islands Division of Fish & Wildlife, Saipan, MP 96950,
Telephone (670) 322-9627

Annual Report Coordinator/Editor:

Dr. Robert E. Schroeder

Western Pacific Regional Fishery Management Council, 1164 Bishop St.,
#1405, Honolulu, HI 96813, Telephone (808) 522-8220

(j:\intr95re.bot)

